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The Welding Engineer

MAY 1943

THE PIONEER TECHNICAL JOURNAL OF THE WELDING INDUSTRY

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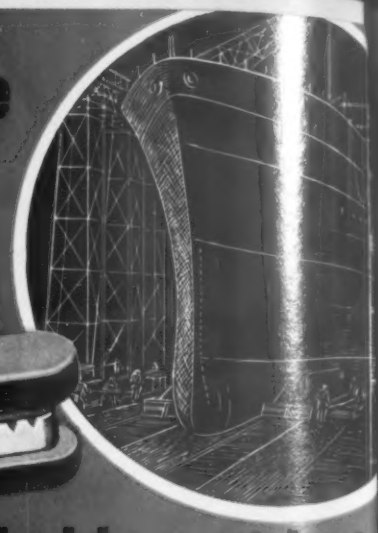

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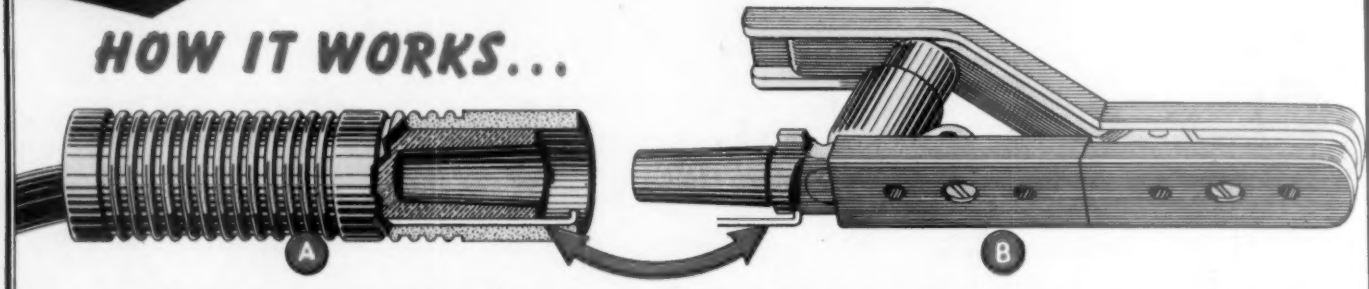
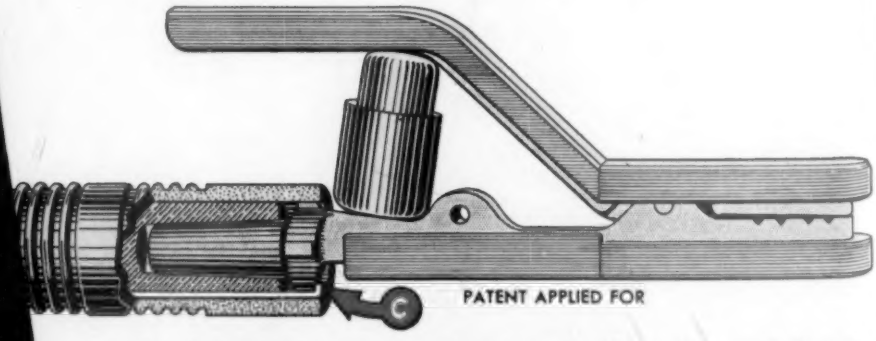


A—*Insulated* handle, containing female section of tapered cable connector which is soldered to cable lead.

B—"Stinger" end showing tapered male section. With a quick twist of the wrist the operator snaps this into female section in the handle (A)—and he's ready to go.



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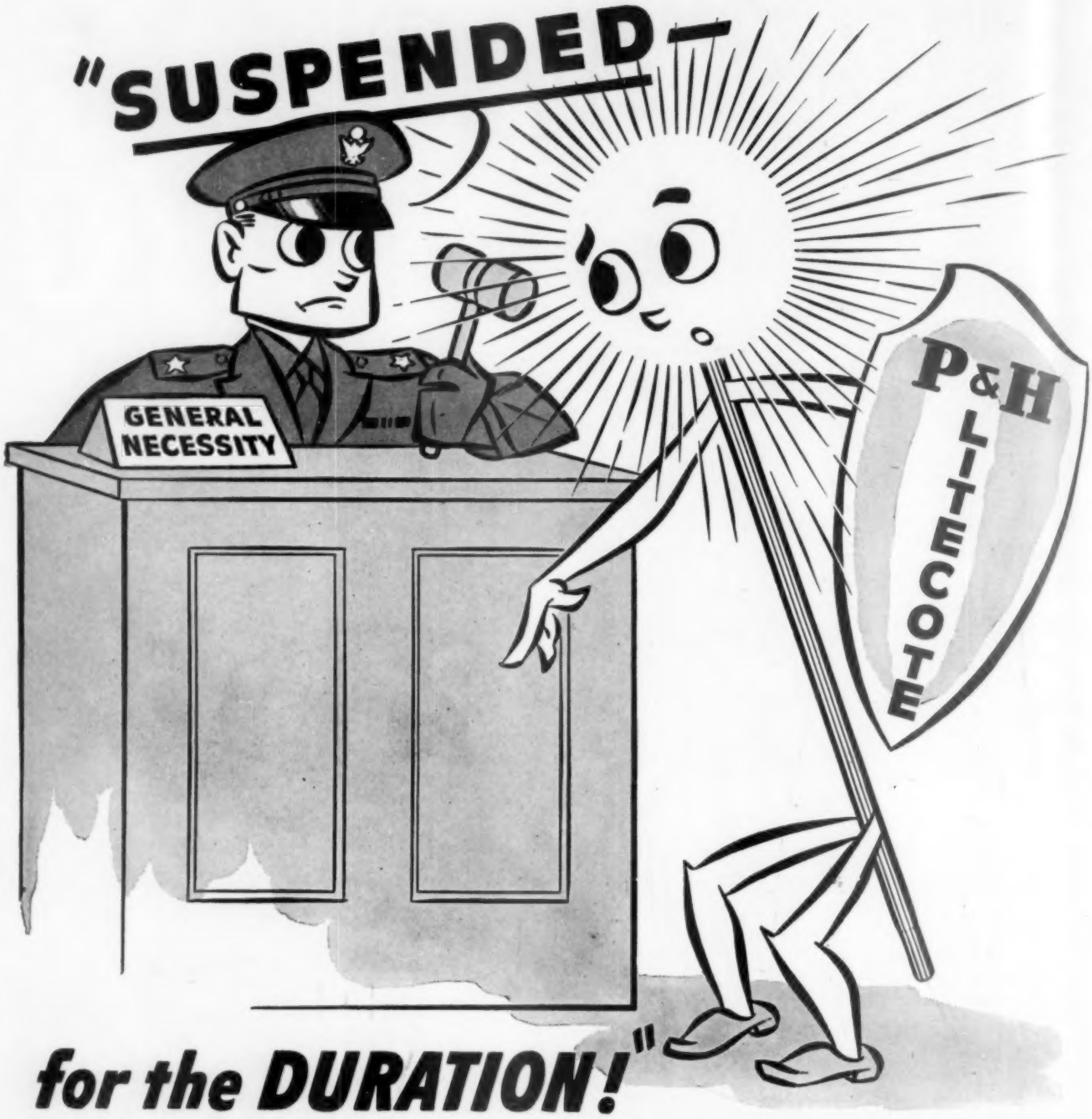

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The Welding Engineer

AMERICA'S PIONEER WELDING JOURNAL

Established 1916

The Ones Who Were Caught

Ten weldors are under arrest! One has already been sentenced to prison for a year and a half. These men—or at least some of them—are guilty of a new sort of crime, one particularly despicable at a time when our nation fights for its life. For the sake of a few more dollars, they would sell us out to Hitler.

Those who were caught represent a group of young men, mostly in their twenties, who for some reason got off to a wrong start in welding. Through faulty training, they failed to develop into true craftsmen. Instead they became greedy individuals whose interest in welding amounted only to what they could get out of it. A dishonest day's work for an honest day's pay is indeed a far cry from the ideals of the real weldor, the craftsman who has been responsible for the present wide scale employment of welding.

We, of the welding industry, are thankful that so many weldors, both young and old, were trained to be craftsmen. Craftsmen are proud of their work. The old weldor has always been proud of his work, and he had reason to be. In the early days, only a skilled craftsman could be a weldor, so it was only natural that the weldor should take pride in his accomplishments.

It was the oldtime weldor who stuck by welding through both the fat and the lean periods. He had confidence in welding, and his confidence and ability instilled confidence in others. He proved beyond a shadow of doubt that welding was as good as any other joining method. As the years rolled by and the welding industry with its engineering skill improved the quality of welding materials and welding techniques, the master craftsman was soon able to prove that welding was not only as good but better, stronger, faster and cheaper than other metal joining methods.

The quality of welding naturally depended upon the weldor, but when a weldor takes pride in his craftsmanship, quality is easily maintained. The early weldors realized that public confidence in welding would mean a broader acceptance of the process and therefore more welding and more work. They strove toward this end, taking pride in doing a good job, hating sloppy work beyond all things. And, after 35 or more years of persistent effort, they succeeded in bringing welding to the peak of acceptance it enjoys today.

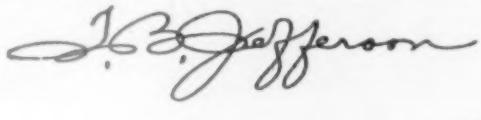
Today welding is a major war tool. Without it, the present day production of planes and guns and ships and tanks would not be possible. It is, therefore, a shock to discover that there exist some weldors (fortunately comparatively few) who are willing to sacrifice pride, self respect, their country, their friends, even their own liberty and their own futures, for the few paltry dollars to be gained by cheating on quality.

Craftsmanship and years of work on the part of others meant nothing to these misguided individuals. Neither did the boys on Guadalcanal and Tunisia. They thought only of themselves. In their greed, they were willing to throw welding to the wolves and the country after it. No prison sentence can possibly be too severe for them.

The ten shortsighted Judases now under arrest had been working on a piece work basis. Piece work or footage welding is an "honor system" affording the opportunity of rewarding the worker in accordance with his ability so that he may earn either little or much depending solely upon himself. Such a system gives the worker, as an individual, the best possible break. Unfortunately, piece work also affords those who do not take pride in their work the opportunity to cheat.

Cheating in welding cannot be tolerated today. The ones who were caught are only small fry, but they will serve as a warning to others who may be tempted to try the same thing that they, too, will be caught and punished.

But the fear of punishment is not enough. Let us train our new weldors to know right and do right—to behave as true craftsmen!



IT BETTER BE *NEW*— AND *NEWS*

This is new. And it's NEWS for every post-war planner. World's largest fractionating tower. It's all-welded. Sets a NEW high in fit-up tolerances and fractionating efficiency—a NEW low in oil refining cost.

ALTER EGO: Yes—and a NEW high in construction savings. Tower shell costs 30.7% less, weighs 15% less. Trays cost 30% less, weigh 54% less—because of arc welded construction.

That's the post-war pattern! Products must obsolete the old models. Otherwise they'll be sales duds. And the same applies to welding procedures.

ALTER EGO: Right! Shops using obsolete methods or equipment will find it tough to buck competition that's set up on an efficient basis.

That IS something to start this post-war thought: Since we will have to fight WITH or AGAINST new equipment and methods, let's plan the NEW by finding out from Lincoln what's NEW in arc welding and how to use it.

Ask your inner self whether old methods will survive after the war.

THE LINCOLN ELECTRIC COMPANY
CLEVELAND, OHIO

then I said to myself—

WELDING IS THE TOWER IN POST-WAR DESIGNS

★ SALVAGE

Tool Salvage by Welding

At a time when both tools and tool steel are difficult to obtain, broken or worn out tools may delay vital war prduction. A new boron-moly-cobalt substitute for high speed steel has been developed to keep tools in service.

By **L. C. GORHAM***
President, Gorham Tool Co.

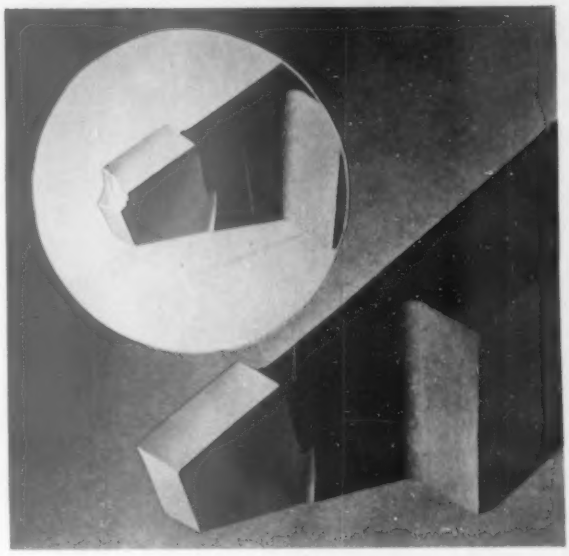


Fig. 2—This lathe cutting tool was chipped as shown in the inset. The corner was built up with new metal, and the tool was drawn and reground. It then gave several times the service it afforded when new.

Just before the United States entered World War No. 1, and while I was in the employ of the Cadillac Motor Car Co. as a tool supervisor, I started in business by salvaging wornout cutters that had been reduced in diameter and thickness by sharpening until there was no longer chip clearance to provide free cutting action. We developed a method of rebuilding and regrinding the teeth without annealing, and many thousands of cutters were put back into service through this salvaging method.

At that time conditions were similar to the present: a great scarcity of tungsten high speed steel as well as a shortage of cutters.

*Paper presented March 26, 1943, at the annual meeting of the American Society of Tool Engineers, Milwaukee.

New Cutting Tools

Though it was a very interesting experience, I eventually disposed of the salvaging business and became a manufacturer of new metal cutting tools. Many changes have occurred in this field in the last 25 years. Among these changes, the shifts from tungsten high speed steel to the molybdenum type and, later, to the type of steel known as 6-6 (a combination of tungsten and molybdenum alloys) have created many problems for the metal cutting tool manufacturer.

During this same 25-year period, there has also been considerable change in the analysis of production material and a tendency to take advantage of the heat-treating possibilities of these alloy steels. These heat-treated production steels require a better cutting material than was formerly required for machined parts. This has been particularly true since automobile production was switched to the production of war materials.

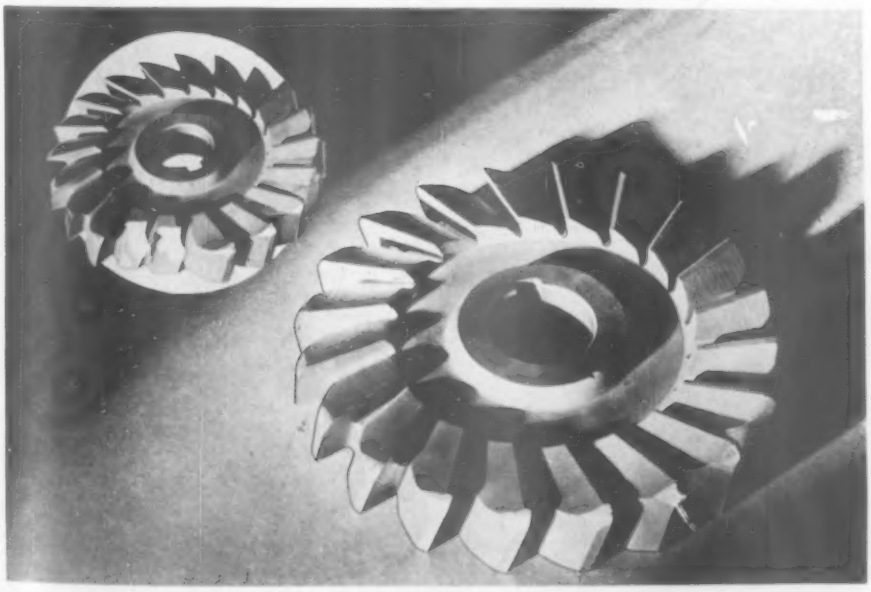


Fig. 1—"Before and after" illustration showing how the newly developed welding metal described in the text may be used to reclaim expensive, difficult-to-obtain milling cutters. This cutter was badly broken as shown by the small inset. New teeth were formed of deposited metal. When drawn and reground to size, the cutter was the equivalent of a brand new one.

Cast Boron Steels

It was the result of research work from the metallurgical and heat-treating standpoints that led to the development of cast high speed steel and welding rod. We found that the addition of a small percentage of boron to the molybdenum high speed steels was of great advantage, particularly in the molybdenum-cobalt type of steel. Hundreds of tons of molybdenum-cobalt-boron steel manufactured to our analyses have already been made up into cutters and turning tools that have proved very satisfactory.

In this type of steel, the amount of the boron addition is limited because of forging losses. The addition of over ½% boron causes considerable loss in the first forging operation from the ingot to the billet, and the recovery is so reduced as to make it commercially impractical to use a higher content than ½% . The boron addition increases the resistance to

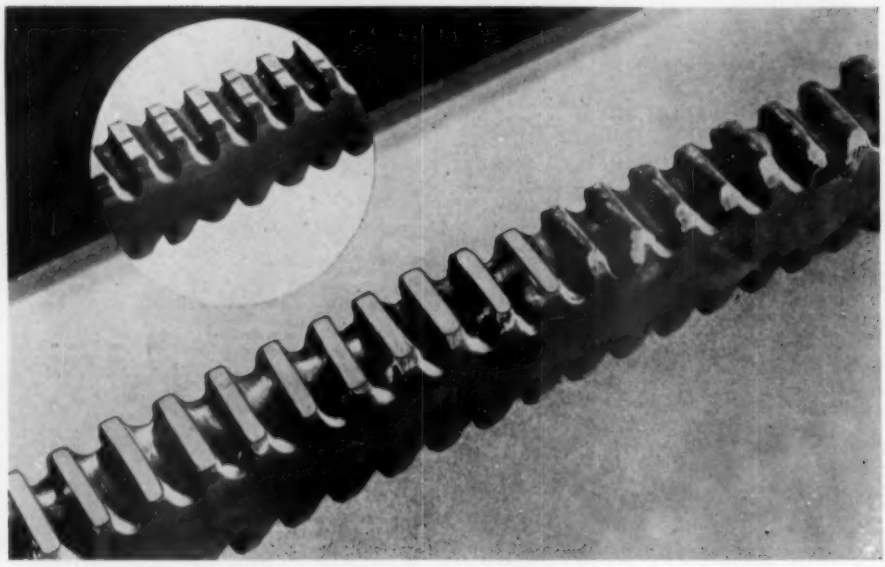


Fig. 3—A good eye may be able to detect the worn surface of the broach as shown in the inset. The larger picture shows how the worn surface was built up with new weld metal (on which rough grinding has already been started). The reclaimed broach will give as good, if not better, service than when new.

abrasion to an almost unbelievable extent, and there are many places where wear resistance is of great importance, for example, of the centerless grinder work rest. Further experiments showed that the molybdenum-cobalt-boron-analyses could be cast successfully to form and that, moreover, the cast-to-form material was more efficient than the forged material, particularly for wear-resistant materials.

Welding Cast Parts

We started to cast material with a higher boron content, giving increased resistance to abrasion. Most of these parts had to be welded to soft machine steel bodies. This was a problem because we could find no satisfactory welding rod. Practically all of the known welding rod alloys were tried without getting what we considered satisfactory results. Finally, we decided that it might be possible to use rod of the same material as our cast pieces for welding the latter to the machine steel bodies. When we made the first welding rod, we were agreeably surprised to find that it had great possibilities. It was of a low melting temperature and (because of the boron in the steel) needed no flux. It was also very easily applied.

New H. S. S. Substitute

The Gorham Tool Co. never intended to manufacture welding rod as we have always confined ourselves to the exclusive manufacture of metal cutting tools. However, some of our customers, who had been allowed to try out samples for maintenance work, reported that it was possible to salvage many of their broken cutters by welding in new teeth and that many broken cutters had thus been put back on the job in a very short space of time, whereas it would have taken weeks to obtain replacement cutters. We were faced with a crying demand for our high speed welding rod.

Believing that this new alloy represents an important contribution to the field of metallurgy, we offer a detailed description here. The new weld metal is a cast ferrous alloy material that incorporates the toughness characteristics of high speed steel while providing the wear resistance of cemented carbide. This welding rod can be used as welded, or it can be welded and afterwards drawn to increase the hardness and toughness. The welded tool can also be annealed, so as to be readily machineable, and subsequently heat treated and drawn. This variety of treatments makes it possible to produce tools and wearing surfaces with hardnesses of 60-70 Rockwell C and also having unusual red-hardness and resistance to abrasion.

The unusual properties of this new weld metal render it highly useful at a time when broken or worn tools may hold up vital war production. It has three general applications: reclaiming of broken tools, lengthening the life of tools and machine parts, building new tools. Each of these will now be discussed.

Tool Reclamation

Typical of the many broken tools which can be reclaimed with this type of weld metal are milling cutters, Fig. 1. Any number of teeth from one to a dozen can be built up with this rod and then reground and heat treated without lowering the hardness of adjacent teeth. Lathe tools (Fig. 2), broaches (Fig. 3), reamers and other tools that are worn out or ground to undersize may be similarly treated and salvaged. Worn or abraded dies (Fig. 4) may likewise be reclaimed through the same welding procedure. Thus valuable time and money are saved while, oftentimes, securing a reclaimed tool that is actually better than new. At a time when both tools and tool metals are exceedingly difficult to obtain, this application is of extreme importance.

It is also possible to prolong indefinitely the service life of tools and ma-

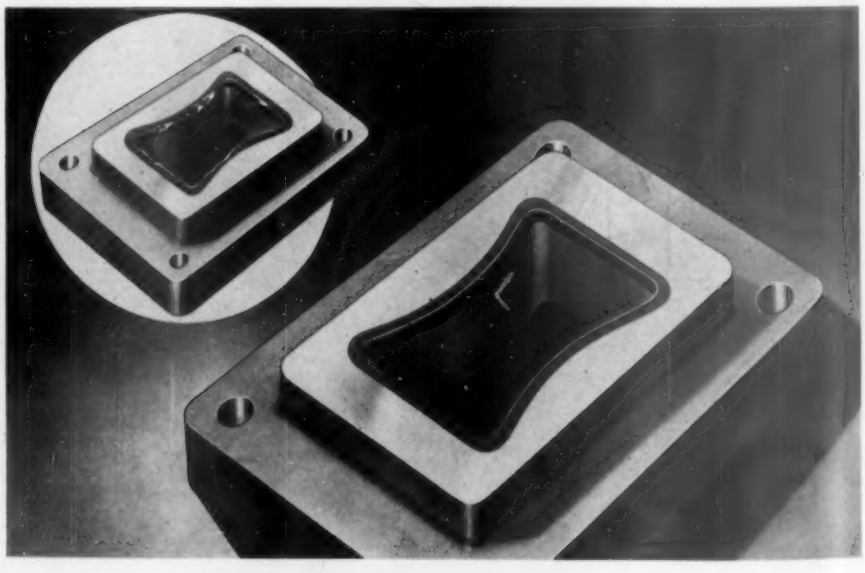


Fig. 4—This forming die had become so badly worn that it was ordered to be junked. Fortunately, it was found out in time that the die could be restored to as-new condition.

chine parts that are subjected to steady wear and high abrasion by depositing a layer of weld metal on the wearing surfaces and grinding to size. Tools whose usefulness may be enhanced in this way include grinder work rests (Fig. 5), lathe centers, shear blades, clutch fingers, gauges, etc.

Making New Tools

New turning and special grooving tools (Fig. 6) may also be made by simply milling or grinding out the end of a piece of shank stock or machine steel and building up with successive layers of the new weld metal. After grinding to size, the tool can be used as welded, or it can be subsequently annealed and heat treated. On some jobs, these special welded tools have outlasted regular high speed tools from three to ten times.

General Instructions

Rods of this type of alloy for the oxy-acetylene welding process are available in diameters of $\frac{1}{8}$, $\frac{3}{16}$ and $\frac{1}{4}$ in. Though the metal is easily applied by an experienced gas weldor, certain general instructions must be followed in order to insure satisfactory results. These are as follows:

The surface to be welded should be reasonably clean. When repairing or building up worn or damaged cutting tools, all sharp corners and edges should be ground down before starting to weld. These precautions are necessary to prevent dilution and the poorer welds which would result.

Preheating is not necessary when building up tools on shanks or machine steel. Preheating to about 800 F is recommended, however, in the repair of hardened parts such as high speed steel tools, dies, etc.

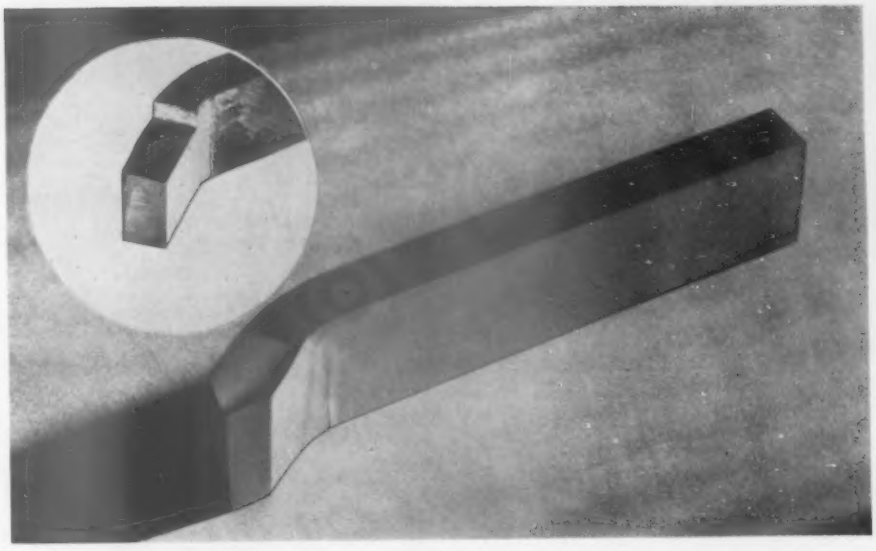


Fig. 6—New tools that are both tough and resistant to wear can be made by building up the cutting edges with successive layers of weld metal and then grinding down to size. The tool shown can be used as welded or welded and drawn. It can also be annealed for machining and then rehardened by the method described in the text.

Welding Procedure

An excess acetylene flame should be used. The surface to be welded is first brought to a sweating heat and then a few drops of molten metal from the rod are deposited and properly fused in. Puddling with the rod should be avoided.

In running a continuous bead, the flame should be held near the edge of the deposit, permitting the molten drops to flow onto the base metal as it is brought to sweating heat. The weldor should take care not to work with too much heat since the rod has a low melting point and high fluidity. In building up successive layers, care should be taken to float out all oxide and scale from the previous deposit. Failure to do this may result in blowholes.

The building of corners or teeth on a cutter can best be done by playing the flame gently around the deposit in order to render it plastic and allowing the metal to flow to the shape desired. A thin oxide layer helps to prevent the metal from running away. When building up new teeth, the flame should be played toward the outside of the cutter in order to keep the hardness of adjacent teeth from being lowered by the welding heat.

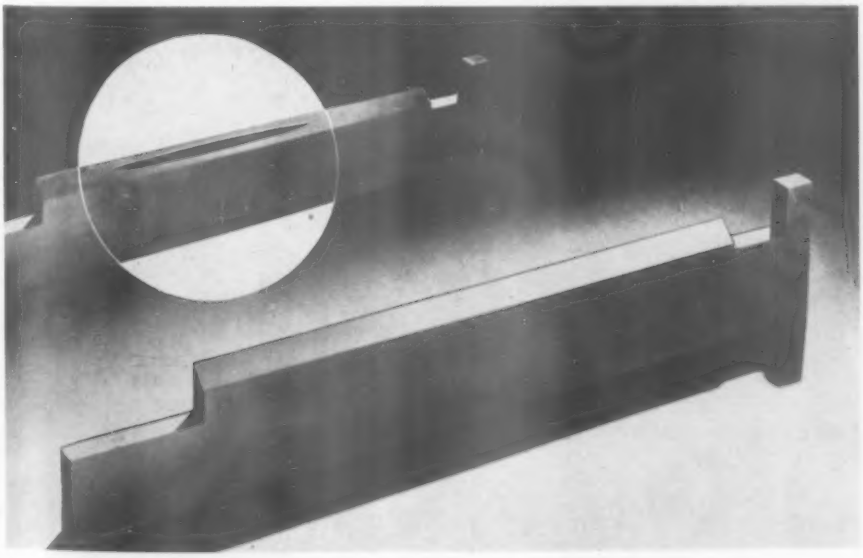


Fig. 5—Centerless grinder work rests are typical of machine parts subject to constant wear. Such parts may have their service life greatly lengthened by depositing a layer of weld metal on the wearing surface. The inset shows the condition of one work rest before it was built up and reground as shown in the larger picture.

Annealing and Heat-Treating

To anneal, the tool is placed in a mixture of sand, cinders and a small amount of spent charcoal. It is then heated to 1,600 F, held at this temperature for approximately 1 hr per in. of container diameter and allowed to cool to below 1,000 F at a rate of 25 to 40 F per hr. This procedure will reduce the hardness to a degree sufficient to permit machining.

After machining, the tool is rehardened by heat treatment. The heat treatment consists of preheating to 1,500 to 1,550 F, furnace heating at 2,000 F, and quenching in air. The tool is then drawn at 1,000 to 1,050 F for about two hrs, depending on the Rockwell hardness desired. A double draw will increase the hardness in most cases.

The same drawing instructions should be followed when the tool is to be drawn after welding but is not to be annealed nor otherwise heat treated.

Fig. 1—The Vultee "Valiant" basic trainer. In these planes, American flyers are given the thorough training which makes them the "world's finest."

Welded Tubular Fuselages

A total of 410 parts are arc welded into one unit at Vultee Aircraft. The welded parts include 110 pieces of chrome-moly tubing, 295 gussets, brackets and fittings of chrome-moly sheet stock, etc. Welding for a completed fuselage is now done in just 23 man-hours.

By **ALAN C. RENN***

Assistant Foreman in charge of Welding,
Vultee Aircraft, Inc.

THIS report on the tubular fuselage of the Vultee "Valiant" basic trainer is not intended so much to make out a case for the entirely arc welded structure as to show the amazing progress that has been attained in the arc welding field itself.

The fuselage is comprised of 15 attachment forgings and bushings, 295 gussets, brackets and fittings of SAE 4130 chrome-moly sheet stock ranging in thickness from 0.035 in. to 0.095 in., and 110 pieces of SAE 4130 chrome-moly tubing. Altogether, a total of 410 parts are arc welded into one integral unit. The wall thicknesses of the tubes and the quantity percentages of each are as follows:

0.035 in.	74%
0.049 in.	13%
0.058 in.	4%
0.065 in.	6%
0.083 in.	2%
0.095 in.	1%

The original engineering estimate was 80 man-hours of welding for each fuselage. When production went into full swing in June, 1940, these figures were lowered to 58 hours at the very beginning. From then on, a steady improvement was made to the present day low of 23 welding hours for a completed unit. I will attempt to show the many factors which have entered into this improvement by comparing the methods used in 1940 with those of the present day:

1. Electrode Sizes

For 1940 and 1942, the sizes of electrodes listed represent the following percentages of the year's total:

	1940	1942
$\frac{1}{16}$ in.	80%	5%
$\frac{5}{64}$ in.	15%	45%
$\frac{3}{32}$ in.	5%	50%

The trend to increased electrode sizes was the keynote in the attaining of our present production rate. Procedures were changed to permit longer continuous welds, and weldors were encouraged to use larger electrode sizes. This, to some extent, was made possible by developing new techniques in manipulation, principally the use of more current and choking of the arc when welding on thin material. In this manner, the operator starts with a normal arc length, shortens the arc and "rides the rod" when the parent metal accumulates excessive heat. The arc is then lengthened shortly before inter-

*Data from a study submitted to The James F. Lincoln Arc Welding Foundation in its recent $200,000 Industrial Progress Award Program.

secting another weld or upon continuing on heavier material, (and vice versa). Another important advantage in the use of larger electrodes was found in the welding of small parts in which the welds were extremely short. A $\frac{1}{16}$ in. electrode is good for making only two half-inch welds, whereas a $\frac{5}{64}$ in. electrode will do for six or more.

2. Subassemblies

The breakdown of the fuselage into as many subassemblies and operations as practicable has had a decided bearing upon the production rate. At present, the operator will now have from three to six jigs to rotate in the building of a section, whereas but one jig was used in 1940. The increased number of subassemblies allows more accessible jigs to be constructed and circumvents waiting by the operators for the parts to be set up.

3. Time and Motion Studies

Time studies have been made and put into practice for the placement of work. Thus the weldors have the correct number of different subassemblies to build or operations to perform on the main frame to make a standard work day. Motion studies have resulted in the use of fast-operating electrode holders and the elimination of a goodly portion of slag removal by hand. The balance is taken care of in the final sand blasting operation.

4. Conveyor Equipment

Vultee has, to the best knowledge of this writer, the first power-driven automatic conveyor line for aircraft welding. This conveyor has eliminated much of the time formerly lost in advancing the stations by hand, which resulted in the confusion of welding cables and the relocation of ground cables and other equipment.

5. Ratio of Quantity to Quality

This has been one of the outstanding problems encountered by supervision and management. At the start of production, emphasis was laid on appearance. This, no doubt, was a carry-over from the day of the hand-made airplane. Our job, therefore, was to prove that arc welding when applied at a rate conductive to high speed production, might be uneven and yet, at the same time, surpass specifications for strength. Once this was proved, we had only to level off at the correct quantity-quality ratio for the most profitable results.

6. Simplicity of Design

With previous welding done with the oxy-acetylene torch, little consideration had to be given quantity production. Hence the "Valiant" fuselage was at first a very intricate design. With the introduction of arc welding, the need soon became apparent for structural simplification. For example, one large tube was substituted in place of several small ones, and one bracket was redesigned to do the work of two or more. Another important advantage was gained by increasing the edge distance of sheet stock parts to permit the operator to weld with speed and ease without burning the edges.

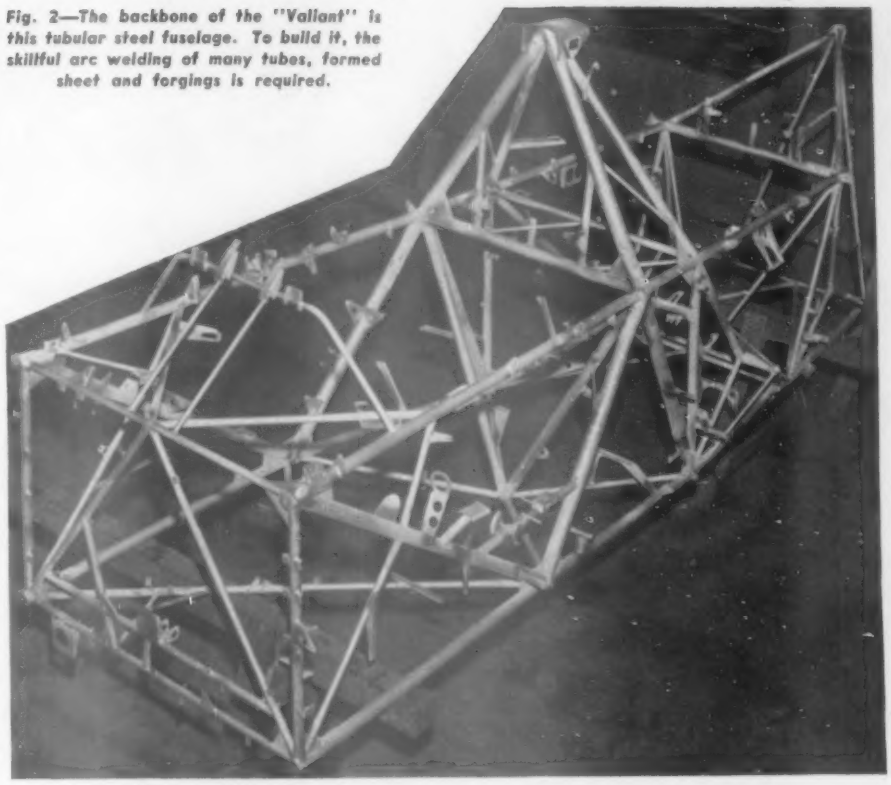
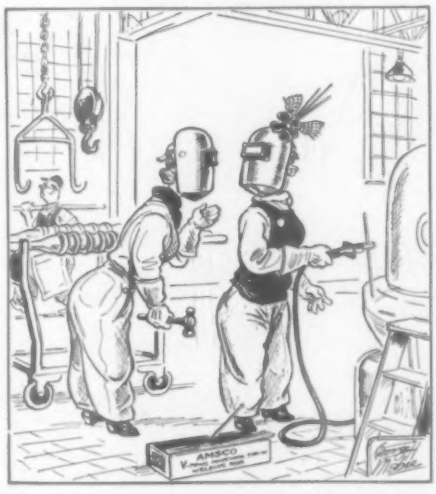


Fig. 2—The backbone of the "Valiant" is this tubular steel fuselage. To build it, the skillful arc welding of many tubes, formed sheet and forgings is required.



Courtesy, American Manganese Steel Div.

"We girls are crazy about your helmet, my dear! How did you get that stunning effect with welding rod and old wire

The results of the foregoing factors may be seen in the following figures:

	Man-hours of welding	Cost per unit
1940	58	$63.80†
1942	23	25.30†
Savings	35	38.50†

As the number of men necessary to weld one fuselage has been more than cut in half, hidden savings—not only in dollars but in precious manpower and material for the war effort—must also be taken into consideration. If twice the number of weldors were needed, for example, we would be compelled to double the amount of tooling and floor space.

Although the total amount saved through the use of arc welding in the past two years is noteworthy, these figures would give a clue to the Vultee war plane production rate at this time and must, therefore, be withheld.

After the War

As we look to the future, we know that newly perfected electrodes, welding procedures and improved equipment will continually add to the efficiency of aircraft manufacture and that arc welding will prove a vital factor in the all-out production effort needed for victory. With the coming of peace, a new and greater field will open for our products, and arc welding will be as effective a tool for the peacetime aircraft industry as it has become during the war.

†Based on an average hourly rate of $1.10.

Shrinking Galvanized Steel

In shipbuilding, it is often necessary to flame-shrink galvanized steel plates after welding in order to overcome distortion. Here are details of a new flame-shrinking method which prevents burning the zinc coating.

By C. R. GOETJEN

Courtesy, Air Reduction Sales Co.

The large spots at the right are evidence of severe burning of the galvanized surface of this plate. The rows of small even spots at left show that the surface is undamaged; these spots were heated by the new flame-shrinking method described in the accompanying text.

SHIP PLATE of ½ in. or less thickness — shell plate, bulkheads, floors, deck plates, etc. — must frequently be flame-shrunk in order to eliminate the buckling incidental to arc welding. The process consists of spot heating with the oxy-acetylene flame and quenching immediately with either water or a compressed air and water mixture. This sequence accomplishes an upsetting action of the metal, resulting in the shrinking (with consequent straightening) of the plate.

Though flame-shrinking is of great aid to shipbuilding, important limitations in its application have been experienced. When the usual neutral or slightly oxidizing flame was employed upon galvanized plate, the galvanized (zinc) protective coating would either be burned or at least roughened to such a degree that sanding would be necessary in order to restore a smooth surface for painting. Furthermore, excessive zinc fumes were liberated in compartments and other confined quarters, necessitating elaborate ventilating systems and a crew of such size as to allow for operators to "spell" each other at short intervals.

Nevertheless, the flame-shrinking process is necessary to the speedy construction of lightweight galvanized steel vessels. Hence the Albina Engine and Machine Works and shipyard, Portland, Ore., carried on an extensive research to find the way to eliminate its objectionable features when used on zinc-coated plate.

A Cooler Flame

During a series of extensive tests conducted at the Albina shipyard, Shrinker Foreman Bill Moore and Shrinker J. W. Black discovered that flame-shrinking could be accomplished without damage to the zinc surface and without objectionable excess fumes if a highly oxidizing flame was applied with carefully controlled technique. The highly oxidizing flame, "starved" as it is of acetylene, is actually cooler than the neutral flame, even though the latter has lesser heat intensity than the slightly oxidizing flame.

In the technique eventually worked out at Albina, a torch with a multi-flame tip having ten No. 60 drill holes on a ⅜ in. diam circle and one center hole was equipped with a water quench ring having a valve for ready shutoff. The quench ring fits about the head of the tip, and the flame and quench are applied simultaneously instead of alternately as in the ordinary flame-shrinking procedure.

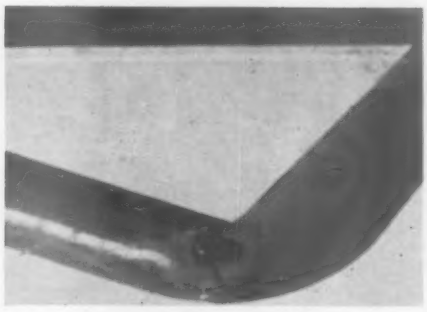
The torch is first adjusted to a soft neutral flame and then "starved" by turning down the acetylene until the inner cones become an intense blue, about $\frac{5}{32}$ in. long. When this condition is reached, the flames are correctly adjusted. The quench spray is now turned on, and the tip is held from ¼ to 1 in. from the galvanized surface until the first sign of color, a dark red, appears.

The withdrawal of the flames at the moment a barely perceptible "flowing" of color is noted on the heated spot is of the utmost importance. The withdrawal must be made very quickly as a mere matter of 2 or 3 seconds delay will result in the destruction of the galvanized surface.

On plates of greater than ⅜ in. thickness, two torches, working on opposite sides of the plate and at the same spot, will give better and faster results. Other than the standard torch, tip and quenching ring, the new method requires no new equipment. It does require a skilled, understanding operator, but the proper instruction can be imparted to any intelligent shrinker, who should become proficient within a few hours.

To teach the new flame-shrinking method, the Albina Engine and Machine Works and shipyard has established a shrinking school. This school, open to representative employees from all war industries and conducted without charge, is certainly a most timely and important contribution to our national war effort.

Agricultural Shop Welding



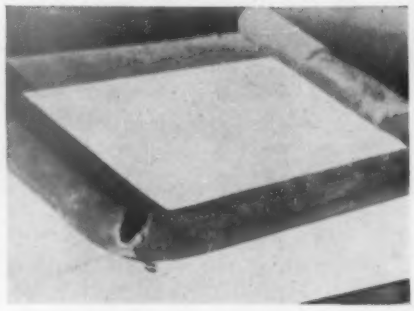


Fig. 1 (left)—An axle from a popular type of plow that has broken in the bend.

Fig. 2 (center)—Axle is tack welded in order to hold it in alignment for welding.

Fig. 3 (right)—After tack welding, axle is turned over and veed with a cutting torch. Vee should extend at least three quarters of the distance through the axle.

The agricultural industry is confronted with serious problems in providing food for our country and our allies. With the curtailment of manufacture of farm machinery, welding becomes a vital factor in maintaining the equipment needed to meet our agricultural goal.

By **W. E. ADAMS**

SPRING, 1943, is bringing many problems to the farmer. While one Government agency is telling him to step-up crop production, other agencies are taking away his labor and restricting his purchases of new farm equipment. Such a combination of circumstances immediately indicates that the farm machinery now on the farm is needed as it never was before. Consequently, it is of the utmost importance that this machinery be maintained in efficient operating condition.

The maintenance and repair of farm machinery, formerly the job of the blacksmith or implement dealer, has now been taken over by the job welding shop because of the shortage of steel and replacement parts. The plight of the job welding shop, like that of the farmer, is also made difficult by many Government regulations. Only recently, for example, has it been possible for the job shop operator to receive a sufficiently high priority to obtain welding rod in order to repair farm machinery.

Up to AA-1 Rating

An order of February 10 authorized WPB regional directors to approve, countersign and issue individual preference ratings up to and including AA-1 on purchase orders for welding rods and electrodes used in the repair of farm machinery and equipment. The same authority was given district managers to approve ratings up to and including AA-2X, a rating which, incidentally, is of little value in the purchase of welding electrodes.

What may be considered the catch in these ratings is that they must not be used for the purchase of material in excess of $25 in value or to supply more than a 45 day maximum inventory, whichever is the lesser.

The above relaxation of requirements insures the filling of purchase orders received by large distributors from local repair shops and from small dealers who service and supply farmers' welding needs. Previously, such purchase orders rarely bore higher than A-10 ratings and thus stood little chance of being filled by distributors whose stocks were continually being depleted by orders carrying higher preference ratings.

Measures for Conservation

When this ruling was made, officials of WPB's farm machinery and equipment division expected that the action would make available a supply of welding rods and electrodes adequate to meet all of the demands to repair farm machinery. Repair men and distributors have been asked to make the most effective use of that supply and to adopt every possible measure to conserve it. It was pointed out to them that bare, dust coated or lightly dipped electrodes containing little critical material, and also that seconds or rejected electrodes, could be used effectively on the average farm repair job where the arc welding process is used. For gas welding repairs, it was suggested that a low carbon rod would be satisfactory on the average job.

It is still too early to decide just how the WPB expectations will turn out, but, for the sake of our country as a whole, it is hoped that the results will be better than many other optimistic guesses by this same body.

No Hard-Facing for Farmers

Other repair restrictions have been imposed upon agricultural machinery by limitation order L-223. Under this order, hard-facing materials can be sold only to a few specifically listed industries. Farming, though one of the biggest users of hard-facing, is not among the industries listed. For work such as building up worn tractor treads, plow shares and similar parts subjected to abrasive wear, it was suggested that a high carbon welding rod be used. Although the deposited metal will not last nearly as long as hard-facing, under the circumstances it is the best substitute available to do the job and keep farm machinery running.

Despite all the difficulties imposed

by priorities, welding has a vital role to play in agriculture. This can readily be seen from the variety of jobs which come into job welding shops in an agricultural community in a single day.

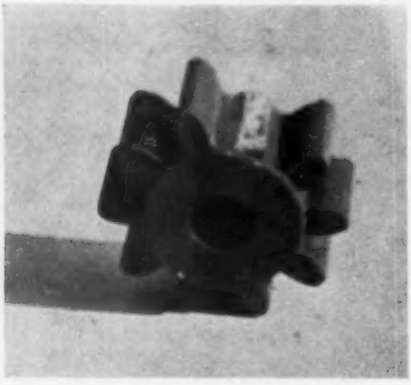


Fig. 4—A cast iron gear with one tooth broken out.

The job shop operator in such a rural community is confronted each day with new tasks—at least one job that will differ completely from any ever undertaken before. Since necessity is the mother of invention, job shop weldors have hence become so resourceful that they can perform near miracles with the welding arc or torch. Because of this unique ability, it is possible for those engaged in this type of work to serve their country best by keeping farm tools rolling. At the same time, of course, the job shop operator is afforded an opportunity to carry on a profitable business.

To those who are unfamiliar with these possibilities, it may be well to describe some of the jobs which come around in the course of a day.

Fig. 5—The gear of Fig. 4 being rebuilt by oxy-acetylene welding.

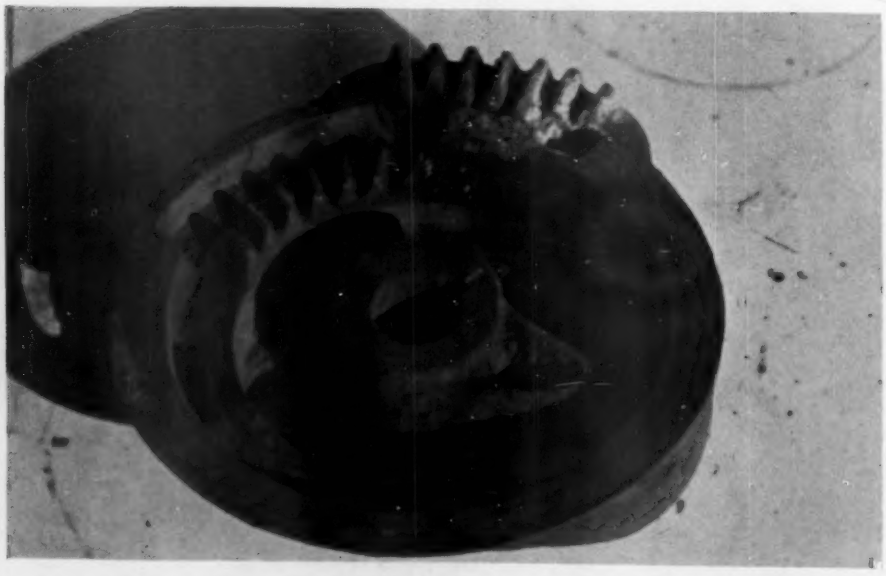


Fig. 6—Binder cam wheel with several new teeth which were made by depositing weld metal.

Axle Repairs

Fig. 1 pictures the broken axle of a popular type of plow. Because of its peculiar offset shape, this axle always breaks in one of the right angle bends. The practical way of undertaking the repair—if the shop were to get a sufficient number of axles—would be to build a jig. However, this is only a one-in-a-while job. Hence it is better to do the work in some manner which, though it may take a little longer time, will be less costly than building a jig. This may be accomplished as follows:

The broken parts are first aligned carefully. Care should be taken in this operation as breaks of this nature sometimes stretch the metal so that the mere fitting of the parts together does not insure their alignment. When aligned, the parts are tack welded on one side, Fig. 2, in order to hold them true during subsequent operations. The axle is now turned over and veed with a cutting torch; the vee should extend at least three quarters of the way through the axle as is shown by Fig. 3. Now the vee is filled by arc welding, and the axle is ready to be turned over for completion of the job.

Having turned the axle over, the weldor again vees the break with a flame-cutting torch. This time the tack weld is cut away. The break in the axle and a portion of the recently deposited metal are also cut away so that the vee extends about half way through the axle. Cutting away the old axle in this manner assures that the weld will not be porous and, consequently, weak. The vee is filled with weld metal, and the job is complete. Axles which have been repaired in this manner, it is found, never again break in the welded bend.

Broken Gear Teeth

A relatively simple operation, which frequently comes into the job shop, is that of repairing cast iron gears with one or more broken teeth, Fig. 4. This type of job is done by using oxy-acetylene welding with a good grade of either cast iron rod or bronze rod for rebuilding the missing teeth.

The important part of this particular operation is the use of a good flux. Either method, that is either cast iron rod or bronze rod, will be quite satisfactory and outlast the original tooth. If care has been taken to deposit the weld metal in rebuilding the tooth, only a small amount of grinding should be necessary afterwards. Fig. 5 shows a gear in the process of being built up. A No. 7 tip with neutral flame was used in this particular job.

Fig. 6 pictures a binder cam wheel which has several missing teeth. The farmer who owned the binder was sure that this repair would be too difficult for a weldor to attempt. The only solution, he thought, would be to obtain a new gear from the local implement dealer. A search of the community soon revealed that this would be impossible so, rather reluctantly, the gear was brought to the welding shop. As may be seen from Fig. 6, the job was successfully done, and less than two hours of the farmer's time were lost in having the gear welded.

A job of rebuilding teeth that is somewhat more difficult is the one involved in the replacement of the internal teeth on the power lift wheel of a plow, Fig. 7. Since, in this instance, it is impossible to grind the teeth to size after completion of the rebuilding operation, a great deal of care must consequently be exercised in getting the correct shape and height with the torch. A cast iron deposit seems to offer the only successful solution for jobs of this nature.

Making Harrow Runners

Another job which will assume considerable importance around this time of year is that of attaching new runners on spring tooth harrows, Figs. 8 and 9. Runners are seldom carried in stock by implement dealers. Their replacement, consequently, is a "natural" for the job welding shop. They are quite frequently made from old wagon tires or any scrap of steel that happens to be of the proper dimensions. The main reason why this fabrication may be done so easily in the job shop is that it has been found much quicker and more practical to tack weld runners onto the harrow than to bolt them into place.

When hard-facing materials were available for the use of job shop weldors in repairing agricultural equipment, it was the custom to hard-face spring tooth harrow runners with about ten inches of hard-facing materials applied by electric arc welding at the point where the runner curves, Fig. 8. A runner treated in this manner will outlast the original factory-made runner many times.

Hard-Faced Harrow Tooth

While mentioning this application of hard-facing, it might be well to call attention to another one, which can be plainly seen in Fig. 9. The tooth of this harrow was drawn out, resharpened and hard-faced about two years ago. Since that time, it has harrowed more than a thousand acres of land and, as can be seen, is still in good condition. Though the hard-facing was a profitable operation for the job shop, it was even more profitable for the farmer in terms of dollars and man-hours saved.

These jobs represent only a few of those that every day come into a job shop in any agricultural community. From these few instances, however, it may be seen that the job shop weldor has a variety of tasks placed before him. The main thing for him to remember (something which every job shop man must take into consideration) is that almost every break will be in some way similar to one which has previously been fixed. With a little thought and patience, almost any type of breakdown can be repaired.

Fig. 7—Power lift wheel of plow with three new internal teeth added by welding. In this case, grinding to size was impossible.

Fig. 8—Runner for spring tooth harrow. Note the hard-facing that was added at the point where the runner curves.

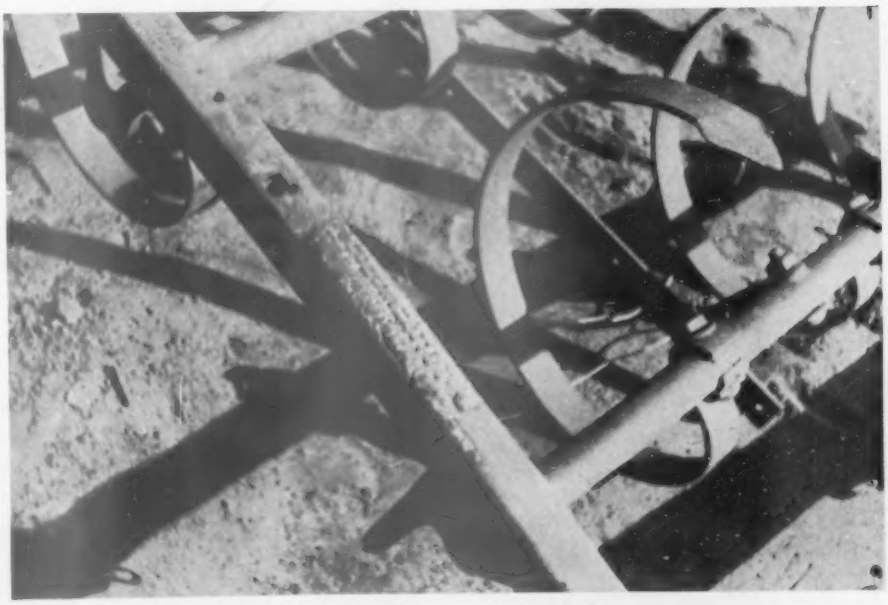


Fig. 9—This harrow tooth was drawn out, resharpened and hard-faced about two years ago. Since then, the harrow has been over more than a thousand acres of ground, but the tooth is still in excellent shape.

Field Maintenance Welding

Fig. 17 (top)—Machine setting, angle of electrode and speed of travel were correct for these welds, but in "A" the length of the arc was held too long and in "B" too short. In "C" the arc was the correct length. Note that "C" is the only satisfactory weld of the three.

Fig. 18 (middle)—Arc length, electrode angle and speed of travel were correct for these welds, but "A" was set too hot and "B" too cold. All conditions were right in "C".

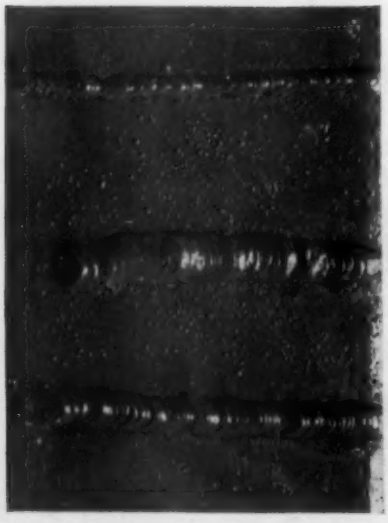


Fig. 19—Machine setting, angle of electrode and arc length were correct for these welds, but in "A" the rate of travel was too fast, and in "B" the travel was too slow. In "C", the only acceptable weld of the three, the speed of travel was correct.

★ Part Three—Mr. Brooking's articles are a manual of virtually everything a serviceman needs know about welding in order to keep heavy equipment in operation. This installment, last of the three parts, tells how to overcome the common difficulties of field welding.

Now that replacement parts are unavailable, field maintenance servicemen are being forced to turn to welding as a means of keeping vitally needed equipment in operation. In his first article, published in the February issue of THE WELDING ENGINEER, *Mr. Brooking suggested a field welding set-up and pointed out possible pitfalls and the means for avoiding them.*

The March article was confined largely to prewelding operations, including cleaning, edge preparation, lining up the parts to be joined, planning to avoid distortion, positioning, preheating, selecting the correct electrodes, and adjusting the welding machine. The present and final installment will discuss the four fundamental arc welding variables, the making of welds in different positions and the welding of bracing and reinforcements on machinery structures.—THE EDITORS.

IN THE actual welding process, the proper control or adjustment of four variables is fundamental to the proper deposition of weld metal. These are:

1. Length of the arc.
2. Angle of the electrode.
3. Setting of the welding machine.
4. Rate of travel.

Length of Arc

This item gives the weldor some freedom in the control of the deposition of metal, but in general the length of arc should be maintained uniformly. The ideal length strikes a balance between a long arc, which gives excessive spatter and a wide bead as shown in "A" of Fig. 17, and a very short arc. The latter, "B" of Fig. 17, tends to choke the electrode down into the metal as it is deposited, thereby causing the electrode to stick and at the same time forming imperfections in the weld.

Angle of the Electrode

In the deposition of welds in any position, the angle at which the electrode is held has much to do with the quality and appearance of the weld. The angle of electrode to the work and to the direction of travel is the main factor in the control of the molten metal of the weld crater. By changing the angle, the weld metal may be deposited more on one place than on another. The degree of penetration into the plate and the amount of metal deposited in the bead in any one place depends considerably on the angle of the electrode. This angle varies for different welds, but it is an important factor in all of them.

Machine Setting

The setting of the welding machine is a very important factor in the production of good welds. As suggested before, the length of the arc tends to give some freedom in machine settings, but for every weld there is a proper setting within certain reasonable limits. If the machine is set too hot, as in "A" of Fig. 18, it is difficult to control the weld, and excessive spatter, unnecessary cutting into the parent metal, and excessive under-

f Heavy Construction Equipment

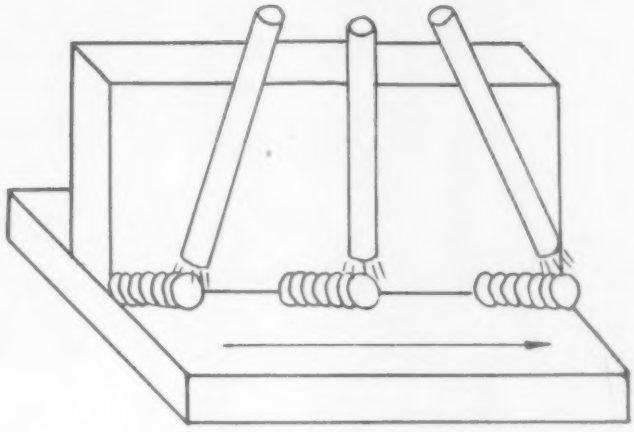


Fig. 20—Arc blow may usually be reduced by leaning the electrode away from the starting point of the weld as shown on the left and then leaning it away from the end point of weld as shown at right.

By **WALTER J. BROOKING**

Director of Testing & Research,
R. G. LeTourneau, Inc., Peoria, Ill.

cutting are likely to be the results. If the machine is too cold, as in "B" of Fig. 18, globules of metal will be deposited in the weld without proper fusion or penetration, and it will be impossible to make either a sound or desirable-appearing weld.

Rate of Travel

The rate of travel of the electrode is the fourth variable which controls the appearance and quality of the weld. If the machine setting is right, the electrode is held at the proper angle and the correct arc length is maintained, then the rate of electrode travel is the sole factor controlling the quality of the weld. Welds produced under such conditions are shown in Fig. 19. If the rate of travel is too rapid, a stringy, thin, poorly-fused weld such as shown in "A" will result. If too slow a rate of travel is used, excessive weld metal will be deposited as shown in "B", and a waste of weld metal and time will result.

In considering the rate of travel, the serviceman should always keep in mind the different weaving motions which may be associated with the forward direction of the weld. These weaving motions will allow him to make either a wide, a deep, a built-up, or a well-puddled weld, depending upon the nature of the job. Quick oscillating motions will allow the gases in a poor piece of steel to escape from the weld metal and will thus help to produce a sound weld instead of a poor weld. By various weaving motions, the metal can be controlled and placed wherever the serviceman wants it to go.

Arc Blow

Occasionally, the arc seems to develop a sort of whirling motion and seems to blow off from the joint in some direction in which the serviceman does not want it to go. This wildness is what is known as "arc blow." It can usually be improved some by changing the place where the ground is attached to the work and sometimes by wrapping the lead around part of the work. A little experimenting, especially with changing the location of the ground, is usually worthwhile because arc blow oftentimes interferes with the most important part of the weld—down deep in the corner or in tying welds together at right angle corner joints.

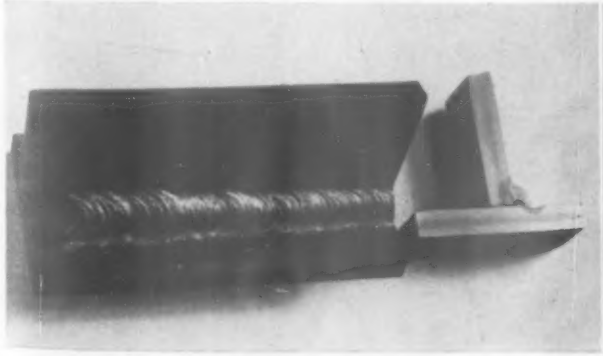
Another method of counteracting arc blow is shown in Fig. 20. The electrode is leaned away from the starting point at the beginning of the weld and away from the end point at the finish of the weld.

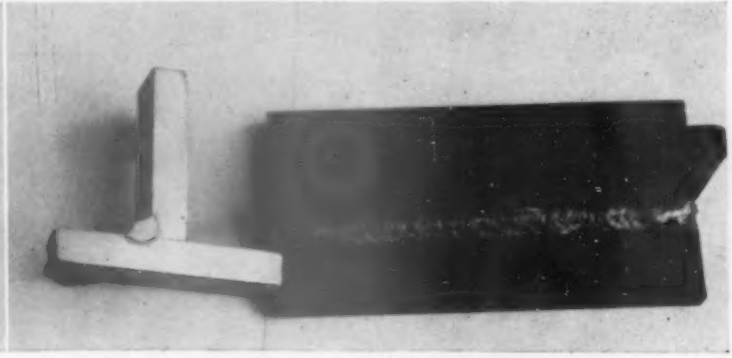
Horizontal Fillets

A large percentage of all welds are horizontal fillets where one plate is horizontal and the other vertical. Great care must be taken to fuse the weld metal deep into the root of the weld and to fuse it solidly with the vertical plate. The weld shown in Fig. 21 looks all right from the surface, but a cross-section shows that it is a very poor weld because not fused in

Fig. 21—The horizontal fillet on the left appears good on the surface, but look at the poor fusion in the root! This weld was too big for one pass, but it was made that way anyhow. Such a weld is very poor and likely to fail.

Fig. 22 (right)—A horizontal fillet weld that is well made, well fused and sound throughout. Note the deep throat and lack of undercutting or overlap. If a similar weld is made on the other side of the vertical plate, this weld is the correct size for the joint. It is too small, however, if only one side of the plate is to be welded.





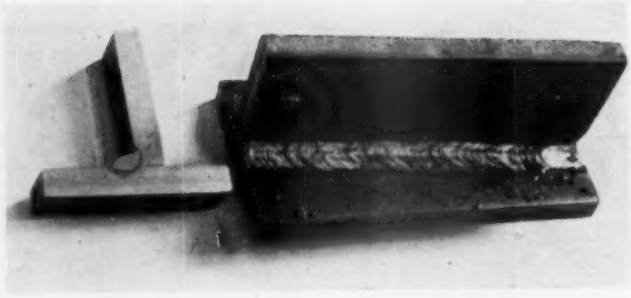


Fig. 23—A horizontal fillet weld deposited with the electrode pointed too directly on the lower plate. Note the undercut at the junction with the upright plate and the wastefully long leg on the horizontal plate. This joint is weak, wasteful.

the root. The weld was too large for one pass, so fusion was sacrificed for size—always a poor policy. As with other welds, the horizontal fillet weld should be made so that the finished weld (throat depth) is greater than the thickness of the thinnest plate in the joint. The throat depth, however, need be little more than half the size of the plate if the plate is welded on both sides, Fig. 22.

Horizontal fillet welds made up of several small beads are very much more likely to be completely sound and well fused on the vertical plate than the small welds made in a few large passes. In making horizontal fillet welds, great care must be taken not to undercut the vertical plate along the top of the last bead deposited. Fig. 23 shows a single pass weld which is undercut badly. This weakens the joint and may cause the plate to break along the upper side of the weld.

If a weldor can consistently make first class, sound horizontal fillet welds, he will have little trouble with the other welds which are ordinarily encountered in maintenance work.

Vertical and Semi-Vertical Welds

Vertical welds must be made sometimes in repairing machinery. In order to make good, sound joints, certain rules must be carefully observed. It is more important, for instance, that the joint be properly veed for a vertical weld than for a flat butt weld where greater amperage or heat will cause the weld metal to penetrate further and make a sounder weld.

Vertical welds may be made either from the bottom upward or from the top downward. There are certain advantages in making welds either way. In general, however, and particularly for plate ⅜ in. and thicker, the serviceman should start at the bottom and weld upward to the top. The reason for welding from the bottom upward on heavier plate is that the electrode has a chance to burn deep into both plates and into the root of the weld. This gives a more uniform fusion and deposition throughout the whole weld. It is often helpful to put a small bead in the joint, starting at the top and running down, to seal it shut. This gives the effect of a perfect fit-up with a slightly rounded corner at the back.

Vertical welds from the top downward make a smoother looking weld, but have some drawbacks. One is that a larger number of thin beads are deposited, which may be, unless the amperage is set exactly right, only partially fused to the layer underneath. A vertical weld deposited from the top downward is also more difficult to clean because the slag is thinner and tends to hold onto the bead tighter. The slag should always be completely removed from these thin passes in order to make sure that the weld is sound. Fig. 24 shows a vertical weld made from the top down which illustrates the weakness of such welds when they are poorly made. No amount of working over this joint will ever make a good weld of it. The only remedy is to chip off the old metal and reweld—preferably from the bottom up.

Overhead Welds

Welds which must be made in the overhead position are usually considered to be the most difficult welds to deposit. Hence the serviceman should plan in every case where it is possible to get his work into such a position that he does not have to make overhead welds.

The overhead weld offers problems similar to those of the vertical weld or the horizontal fillet plus the complication that the work is up over the head of the operator and is more difficult to see. Care must be taken to fuse the metal deeply into the root of the weld and to clean each successive pass.

Those who learn to weld overhead will often find that their best welds are made in this most difficult position. The reason for the seeming contradiction is that all welding conditions—current, position of electrode and speed of travel—must be correct in order to deposit metal overhead.

In making an overhead T-joint, most operators seem to find that it is easier to deposit the first bead directly onto the bottom of the joint. The next is put on the horizontal plate, and the third bead goes on the vertical plate to tie the other two beads together.

In making overhead welds, the serviceman should always remember to grasp the electrode holder with his knuckles upward (see Fig. 25) so that sparks and weld spatter drops will bounce off from his gloved hand instead of lingering in the palm of his hand where they may be able to cause serious burns.

Horizontal Welds

Horizontal welds are very much like overhead welds in the problems which they create for the serviceman. The most important rule is to be sure that each successive pass is completely cleaned; this is necessary in order to make sure that the pass is completely fused on the upper side of the top plate. As in horizontal fillet welds, the serviceman must take great care to prevent undercutting the upper plate in order to keep the weld from weakening the joint.

Bracing Machinery Structures

In the repair of welded machinery, it is sometimes necessary for the serviceman to weld braces onto the broken or bent structures of the machine which he is repairing. This part of his work is one which it is very important to study carefully before going ahead with the actual job.

Fig. 24—The center upright weld in this structure was poorly welded from the top down. If the metal had closed over the porous holes, the weld might have been mistakenly passed as a sound weld, evidencing the value of slag removal on vertical welding. The joint is hopelessly poor; the metal should be chipped out and the plates rewelded from the bottom up.

Fig. 25—The electrode holder held with palm up as shown on the left may allow spatter drops to roll into the welder's hand and cause severe burns. Holding knuckles up as shown to the right allows the sparks and spatter to bounce off the hand.

Braces and reinforcements should never be put on the structure of a machine unless that structure is definitely failing because of overload or some other cause. No reinforcement should ever be put on a machine just because it looks weak and looks like it might fail. If a brace or reinforcement is needed on a structure, the fact must be determined by careful study of the way that the structure carries the stress while in operation.

When braces are needed, there are certain materials which should be used and certain others which should not be used. In general, strips, straps, bars and box sections with caps welded on the ends are the best. To these may be added channels (in cases where both legs of the channel can be welded to the structure to form a boxlike section) and sometimes I-beams. Ordinarily, angles and T-irons are of no more value for bracing than a strap of thickness equal to that part of the angle or T-iron which lays flat and is welded flat to the structure. The web that sticks out is not sufficiently superior in strength to a strap to be worthwhile.

Parallel, Not Crosswise

After studying the structure, the serviceman should plan his bracing so that the braces will run parallel (or nearly parallel) to the load as it is carried on the part of the machine being reinforced. A brace should never be put all the way around a member, nor crosswise with the main load, nor should a brace be put on a main member in such a manner as to cause the welds to run across the member.

In general, braces should always be placed lengthwise with the load of the structure, and the welds should be likewise placed lengthwise, never crosswise.

Fig. 26 shows the welding of braces which go lengthwise with the member in the proper manner. Note that the ends of the braces should never be welded. Welds on the ends are unnecessary from a strength standpoint and only tend to weaken the main structure because of the effect of the heat of the weld metal.

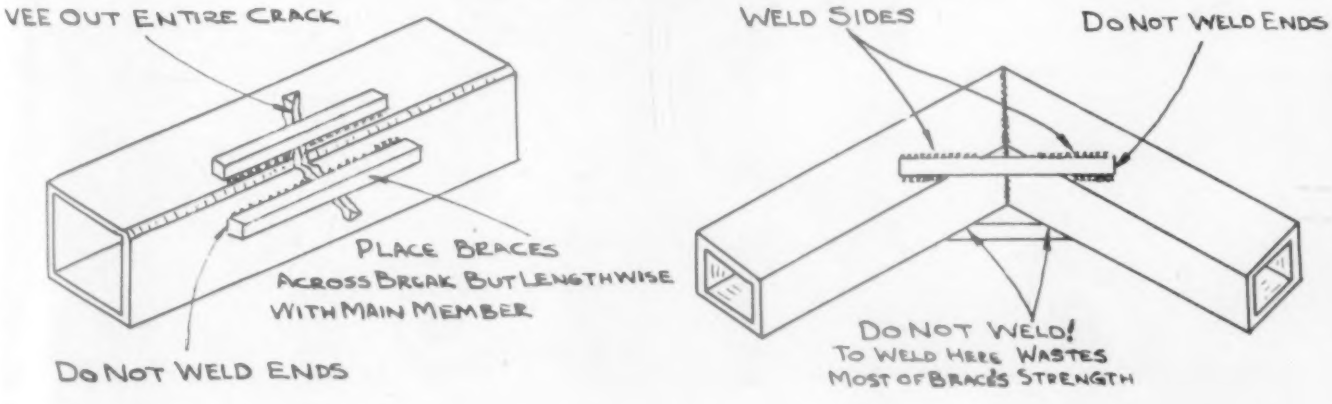
In putting a brace across an angular structure or a curved structure where the brace stiffens a main joint of a part of a machine (Fig. 27), the ends of the brace should not be welded unless a capped boxbeam is used for a brace; in that case, only a small weld should be placed at the end of the beam, welding on the cap but not welding to the main structure. The sides of the beam, bar, or reinforcing strap should be welded, but the area towards the inside or underneath part of the braced structure, where the surface of the brace begins to leave the structure, should never be welded. These inside welds are pointed out in Fig. 27. They should never be welded because then all of the stress of the load which the brace or reinforcement should carry is thrown on those first two welds, actually serving to cut the brace in two. If the inside welds are made, then all of the welding on the rest of the structure is worthless.

In concluding the subject of bracing, it should again be emphasized that: (1) bracing should not be placed unless absolutely necessary; (2) braces should always run lengthwise — with the main load, never crosswise or all around a structure; (3) in general, the ends of braces running parallel with the main load on a structure should never be welded.

THE END

Fig. 26 (left)—On structures such as these, this type of reinforcement should be placed lengthwise and welded on the sides only, never across the ends.

Fig. 27 (right)—When braces span parts of a curved or angular member, the inner "reinforcement-to-member" surface should never be welded. Such welds weaken the reinforcement and also make the welds on the sides useless.



Brazing* a 7,100 Hp Turbine Speed Ring

By CLYDE B. CLASON

★ Part Two—Brazing with an oxy-acetylene flame effected swift and economical repair of the 37,000 lb speed ring for an important 5,000 kw hydro-electric plant. This big job took 540 weldor-hours and necessitated the development of special welding techniques.

Turbine No. 1 at the Black Canyon plant of the U. S. Bureau of Reclamation was shut down because of a broken speed ring. The damage was extensive, 14 of the 16 vanes of the cast iron ring being broken either partially or completely in two. Because of the great difficulty of securing a new casting under wartime conditions, it was decided to effect the repair by brazing.

Part I (pages 29-31, April, 1943, issue of THE WELDING ENGINEER*) discussed the preliminary operations of chipping out the broken joints, securing alignment, preheating and the furnishing of adequate ventilation to protect the men from zinc fumes. The present and final installment will cover the actual brazing job.*

ANOTHER big problem encountered in the repair of the 37,000 lb speed ring at the U. S. Bureau of Reclamation's Black Canyon plant was the securing of competent men. The work was difficult, about 90% of the welds being either horizontal or overhead. It was necessary, therefore, to shut down the job for a day in order to train the men in techniques suited to the peculiar nature of the task.

As previously stated, the hollow cast iron vanes measured 1 ft, 7½ in. across and extended 29.5 in. between the upper and lower wearing plates. Fourteen of the 16 vanes were broken. The types of breaks and the days on which the vanes were welded are given in Table I.

Welding Order

Most of the breaks, it will be noted from Table I, occurred at the bottom. Reference to this tabulation also reveals that the welding was begun with Vane No. 11 and that the vanes were welded without any apparent order of rotation. It was thought at first that it might possibly be best to "skip weld," probably welding vanes on opposite sides of the speed ring in order to distribute the heat so as to keep distortion to a minimum. After the jacks had been placed, however, it was decided that the vanes could be welded in any order that proved the most convenient.

The welding order selected is significant in that it gave the opportunity to develop the welding operators by beginning under easiest conditions. The first few welds, it may be noted, were all bottom welds and were made where the area in the scroll tube was of fair size.

The first successful welded vane, a bottom weld, required approximately 8 hr. The last two bottom welds were made in about 9 hr total time for the two. The overhead corner welds were the most difficult. The first, made after some five days of bottom welds, required about 9 hr. Later the operators were able to complete some of these welds in 6½ hr.

Weld Specifications

The Bureau's specifications provided that the welding should be only ½ in. thick, or approximately one third the thickness of the metal, thus filling the chipped groove. The weld metal, in most cases, was 2½ in. wide. It was believed that such a weld would develop approximately the

Table I. Speed Ring Vane Data

Vane No.	Type of Break	Day of Month Welded
1	Top and partial bottom	15
2	Full bottom and partial top	16
3	Full bottom	17
4	Full bottom	17
5	Full top and part bottom	12
6	Bottom	11
7	Full top and part bottom	10
8	Full bottom	8
9	Full bottom	7
10	Full bottom	6
11	Full bottom	5
12	Partial top	13
13	Partial top, confined to outer edges of vane and lip of casting	13
14	Not broken.	
15	Not broken.	
16	Full top and side break up through lip of casting	14

*Brazing is defined by the American Welding Society as: "A group of welding processes wherein the filler metal is a non-ferrous metal or alloy whose melting point is higher than 1,000 F but lower than that of the metals or alloys to be joined." This process is also referred to as "bronze-welding" in some instances.

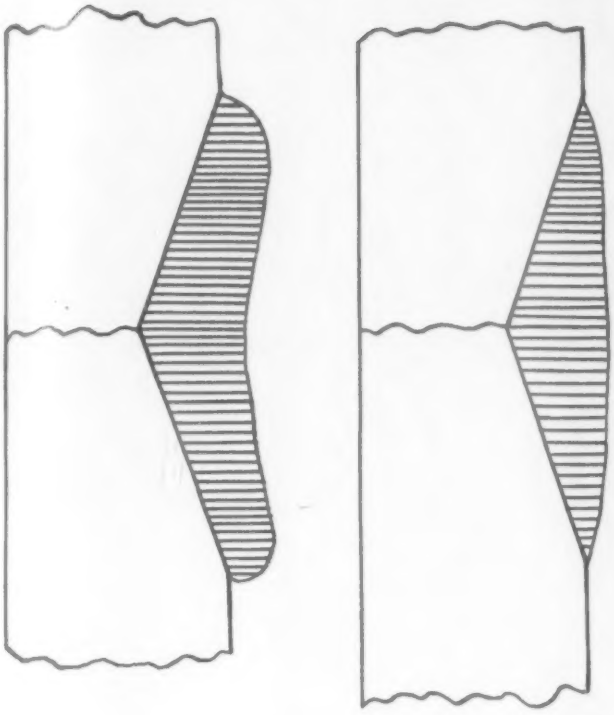


Fig. 8—The welds were generally placed in layers in the general contour shown at the left. This gave a shelf to work on at all times. At completion, the weld was flame-dressed to give the contour shown at the right. About 90% of the welds were either horizontal or overhead.

same strength as the original cast iron. The welds were placed in layers (see Fig. 8), giving at all times a shelf on which to work. When a weld was completed, it was dressed off with the flame, leaving—at the most—an approximate ¼ in. reinforcement of the contour shown at the right of Fig. 8.

Three distinct welding techniques were employed. Before discussing them in detail, it might be well to say that there were certain factors which had to be considered because of the cast iron construction of the speed ring. Cast iron has a tendency to overheat readily. Hence, the prime consideration was that of accomplishing the welding operation while using a minimum amount of heat.

Horizontal Welds

The first technique was developed for the making of horizontal welds where it was quite vital that the flame be kept from the base metal. This object was accomplished by directing the flame down on the bronze of the weld, thus keeping the parent metal comparatively cool. On the horizontal breaks, the weld metal was built up in layers (see left of Fig. 8), which were usually not more than 10 in. long. As a rule, these layers of weld metal were deposited uniformly to the halfway mark before closing the crack in the broken vane.

Two Torches, Overhead

The second method was primarily an overhead technique and was marked by the employment of two torches in the immediate zone of the weld. This method was used when the parent metal was so heavy as to require more heat than one welding operator could furnish and still maintain control of the flow of his bronze welding rod. To overcome this difficulty, one operator placed the metal with his torch while another operator used a second torch to assist in the heating of surrounding metal.

Overhead Corners

The third method was also an overhead technique and was employed for overhead corner welds. The first step was to build up a slight, narrow shelf which, after a fashion, formed a dam extending across the bottom of that area of the vee above the shelf. This left a pocket inside the vee. As welding progressed, the pocket was finished flush with weld metal, and a new dam or shelf was built. Thus the job was completed by alternately extending the shelf forward, then depositing metal above and back in the pocket. The several extensions of the shelf provided adequate support for the weld metal during the entire overhead welding operation.

The torches showed their quality in these pockets. It was not at all uncommon to see an operator remove the flame from the welding zone with

Fig. 9—This welder is brazing overhead while another worker preheats the vane to balance thermal stresses.

Fig. 10—At times two welders were simultaneously applying filler metal to a single vane.

the torch tip red hot, dip the rod into the flux and continue welding. Even with the tip red hot, there was seldom any backfiring.

Overheating Avoided

It cannot be emphasized too strongly that the cast material was very sensitive to overheating. Because of the danger of overheating the parent

Fig. 11—Peening with an air-operated hammer was important to the success of this cast iron repair job.

metal, the flame could not be allowed to approach horizontally into the bottom of the vee. The operator had to puddle his bronze and play the flame rather directly on the puddle at all times.

After the proper techniques had been developed, the removal of the flame from the weld at any time seldom showed more than a fleeting glimpse of any red glow.

In most cases, two welding operators worked on the same vane simultaneously while a third man was preheating the vane next to the one being welded. Occasionally, three operators worked on the vane at one time. The finishing, naturally, was done by one man.

Peening and Cooling

At the completion of a weld, the jacks maintained full tension for a short time, and the weld was peened lightly with a pneumatic hammer. The jacks were gradually released as the peening continued; when the weld had fairly well cooled, the jacks were released altogether, and a measurement was taken. If the vane was found to be a trifle short, the jacks were extended again, and further peening was carried on until the desired measurement had been attained. In order to prevent contraction of the joints during cooling, the jacks were left under strain as long as it was possible to leave them in position, and always until after the weld had cooled.

Light peening was done in the middle of the weld while it was hot. The peening was carried out over the edges of the weld onto the cast iron as the vane cooled, the heaviest peening being done when the iron was cold. The peening was done with tools having slightly rounded ends and gave the finished welds a burnished appearance.

A large amount of air was constantly passing over the area of the weld because of the forced ventilation system described in Part I (April issue of THE WELDING ENGINEER). This forced circulation of ventilating air was continued exactly during cooling as during welding. Usually, not more than two hours were required to get the casting down to a temperature at which the hand could be held on the weld.

540 Man-Hours of Welding

Even though welding was, comparatively, a small part of the total repair cost of this turbine speed ring, a total of about 540 operator-hours were charged to it and not less than 300 hr were required for the chipping. Helpers' time is not included; the working time of each helper was distributed between so many tasks that it was difficult to ascertain the time spent on any individual phase of the job.

Final check measurements revealed a total of 69 ft, 10 in. of welding. There were used on this job about 700 lb of $\frac{3}{16}$ in. alloy bronze rods, about 35 lb of $\frac{1}{8}$ in. alloy bronze rods,

Fig. 12—Top and bottom welds in vanes 1 and 2. This view is fairly characteristic of the general breaking up of the vanes. Some breaks, however, did not show until the weld was made.

about 50 lb of flux and about 16,000 cu ft each of oxygen and acetylene.

* * *

The author wishes to thank B. H. Higgs, The Linde Air Products Co., Salt Lake City, and the Bureau of Reclamation, Denver, for much of the information contained in this article. Acknowledgment is also made to The Linde Air Products Co., New York City, for the photographs.

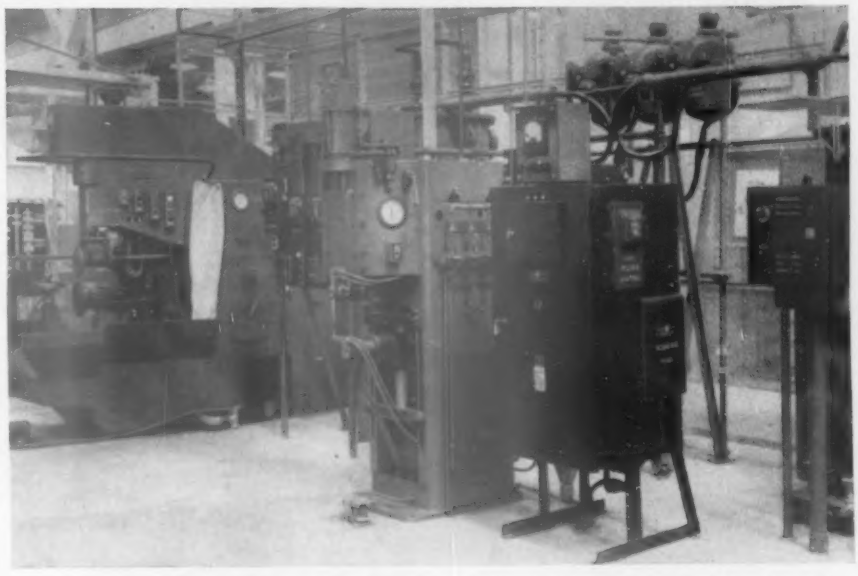
THE END

Fig. 13—Looking down from the top across the center of the speed ring. The entrance of the penstock to the scroll case may be seen on the left side.

Controls for the War Effort

By **H. L. PALMER***

Electronic Section, Industrial Control Engineering Dept., General Electric Co.



Resistance welding installation showing welders and associated electronic control equipment.

This mechanized war calls for improved, faster methods of fabricating both light and heavy gauge metals. The fabrication must be of the highest quality, yet the work must be so simple that it can be done by even unskilled workers. Resistance welding is one answer.

IN THIS mechanized war, the need is urgent for faster, better methods of fabricating both light and heavy gauge metals. Prominent among such methods are recent developments in resistance welding controls which are materially aiding industry's war output.

Welding Improvements

Energy storage resistance welding, of both the capacitor and inductor type, has been extensively developed as an improved tool for the welding of aluminum. Conventional A-C resistance welding control has been expanded to meet the exacting requirements of welding the many new alloys made available for war use. There has been developed a current regulator that will maintain constant current through the weld even though the line voltage may vary or the secondary throat conditions change. Special sequence controls are available to meet any cycle of power applications found necessary to weld and heat treat the material to be fabricated. The demand on overloaded lines can be reduced by means of power factor correction.

Today's Problems

The building of war machines for this mechanized war has taxed to the utmost our metal fabricating methods. The problem has several aspects. For example, many new special alloys have been brought into common use, necessitating new techniques. Though the fabrication must be of the highest quality in order to withstand the abuses of wartime operation, the process must be such that it can be done by comparatively unskilled men or women. Finally, the production rate must be in keeping with the rush requirements of war.

The four common methods of joining metals are riveting, arc welding, gas welding and resistance welding. There are, of course, other methods such as thermit welding and brazing by arc, torch or by induction heating, but of all of these only resistance welding falls within the scope of this paper.

It is not the intention of the author to go into the merits of one welding method over another, but to summarize the efforts and accomplishments of resistance welding control manufacturers to keep resistance welding in the front line of the production battle.

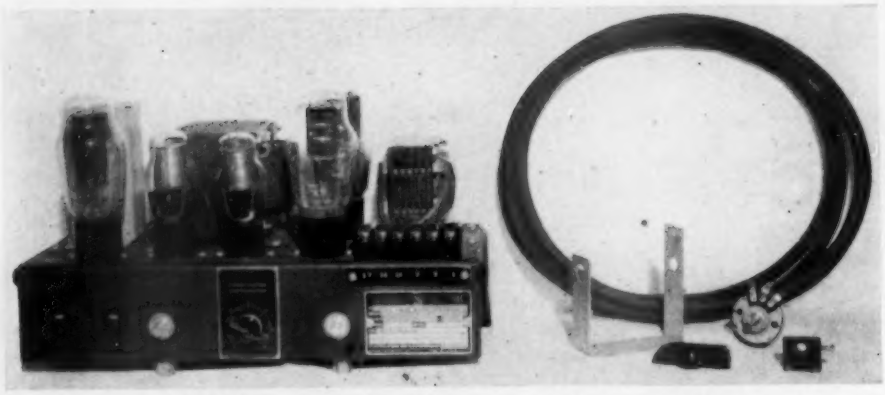
The new developments (except perhaps for the work done on certain armor plate alloys) would have eventually been developed in peacetime, the difference being that several normal years' developments have been crowded into one. The gratifying part of it, however, is that when peace comes the new techniques and equipment will also simplify and improve the production of peacetime commodities.

Energy Storage

In energy storage welding, electrical energy is drawn from the line at a reduced rate between welds, stored and then released as needed for the purpose of creating welding heat. Energy storage welding is widely used and generally accepted for the production welding of aluminum alloys.

The increased use of aluminum alloys has renewed and speeded the development of two energy storage welding methods; namely, capacity or electrostatic storage and inductive or electromagnetic storage. Either of these methods has one important and undisputed advantage over the conventional A-C resistance welding method—the lower demand on the electric power system. In addition, much evidence of higher quality welds and lower electrode maintenance has been presented. The mag-

*Presented as a conference paper at the Northeastern District technical meeting, American Institute of Electrical Engineers, Pittsfield, Mass., April 9.



Electronic voltage compensator, which compensates for variations in line voltage, as used with thyratron resistance welding control.

nitude of these advantages must be weighed against the increased first cost of energy storage welding.

Power Advantage

There is a dual power advantage. First, the duty cycle (ratio of the time the control is conducting current during the averaging time of a given tube to that averaging time) is increased as the weld energy is absorbed over a longer time, therefore reducing the instantaneous kw demand. Secondly, the power that is drawn can be divided between the three phases of the power system.

In both energy storage methods, three-phase A-C current is taken from the lines and rectified. The direct current from the rectifier is used either to charge capacitors or to build up flux in an iron core reactor. In the capacitor, the energy is determined by the value of the capacitance and the square of the voltage to which it is charged. In the inductance, the energy is determined by the value of the inductance and the square of the current flowing when it is interrupted.

In both electrostatic and inductive methods, the power impulse to the weld is unidirectional, and the wave shape can be varied by altering the circuit constants. This wave shape is changed as is necessary to suit the requirements of the thickness and type of alloy being welded. The variable wave shape requirement makes it necessary to build the control for the capacitor discharge welder with a range switch which will permit changing the number of capacitors and to provide the rectifier with a variable-voltage regulator.

A-C Welder Control

The control of an A-C resistance welding machine must embody a means for precise switching of the low power factor load in accordance with the requirements of the welding technique for the particular job. The control can thus be divided into two parts: power switching and timing or selecting. In addition to these general problems, specific welding requirements have demanded special controls. Examples of these are power factor correction with series or parallel capacitors, current and voltage regulating compensators, and "program" welding for heat treating special alloys.

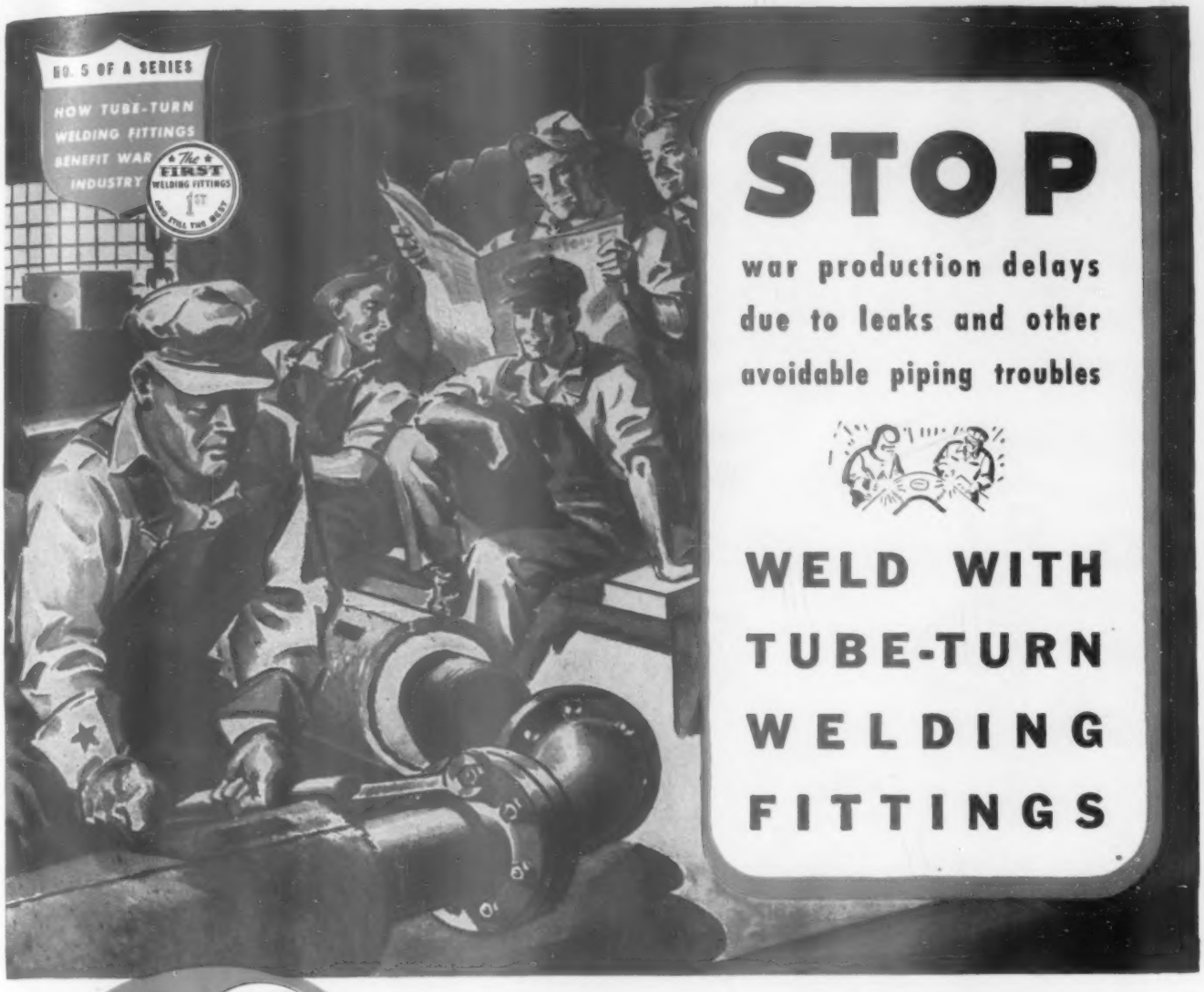
Functionally, the switching and timing technique has not been forced to undergo any major evolution. The standards were well established over a period of some years, and the welding requirements for our present war effort can easily be met. The welding of heavy sections has in some cases required more current than can be handled by one pair of inversely connected ignitrons. By the use of suitable reactors and transformers, however, two pairs of ignitrons can be made to divide the load so that approximately double demand kva can be handled. Where the demand is not too high for one pair of tubes but the conduction is long or the duty cycle is high, two pairs of tubes can be used to divide the load by switching the load from one pair of tubes to the other at frequent intervals. Thus, the average current rating can be practically doubled. Through such methods as these, the control manufacturers are meeting the war demand for larger welders operated at higher speeds.

Current Controls

It is an accepted fact that the presence of magnetic material in the throat of a welding machine decreases the magnitude of the welding current. Because of this, the heat control has to be changed as work progresses into the throat. Again, the use of heavy gauge material aggravates this condition. In one case, the welding current would change as much as 30% from the first weld to the last weld. Control designers have now solved this problem with a current-regulating compensator.

If the current flow in a weld were continuous and no starting problem were involved, it would be a simple matter to regulate the current to a

Energy storage control of the capacitor discharge type (left) and rectifier (right) for use with electromagnetic stored energy type resistance welding machine.


NO. 5 OF A SERIES
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war production delays due to leaks and other avoidable piping troubles
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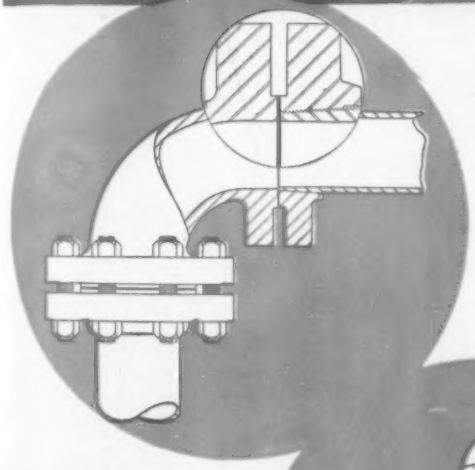

Contrast these diagrammatic drawings and enlarged cross-sections of a flanged ell (*above*) and a Tube-Turn 90° welding elbow (*below*) in a line. Note how the *welded* connection forms virtually a continuous tube without joints. Welding with Tube-Turn fittings *eliminates* the many maintenance headaches inherent with mechanically connected piping: leaks, gasket changes, bolt tightening, caulking, threading, difficult covering, and other inefficiencies that can seriously hamper war production.

REMEMBER these common-sense facts before you install new piping systems or replace old sections: welding with Tube-Turn fittings insures *permanently leakproof, trouble-free joints* and better fittings that last as long as the pipe itself. You banish many maintenance troubles which seriously interrupt the vital *piping arteries* that keep war plants going.

In addition, Tube-Turn welding fittings give you *greater strength and safety;* uniform wall thickness, for *easier, faster alignment and welding;* compact piping layouts that *save space, weight and installation time;* smooth inner walls that mean far *better flow, less corrosion* and *greater piping efficiency.*

TUBE-TURNS (INC.), LOUISVILLE, KY. *Branch offices:* New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Tulsa, Houston, Los Angeles. *Distributors in principal cities.*

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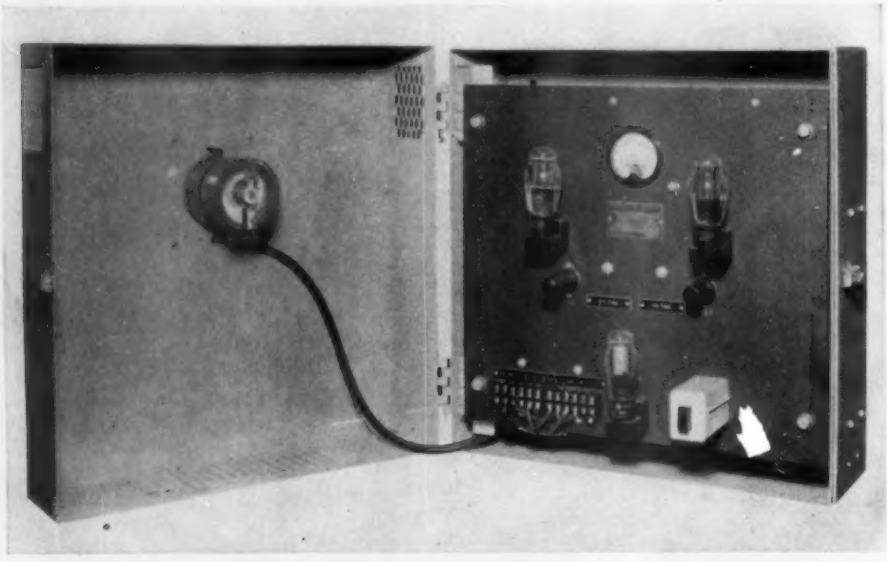
constant value. The conditions are such, however, that the current must start and stop frequently, and a conventional regulator will have a serious starting problem because with no current flowing (which is the condition between welds) the regulator will advance the phase control in a vain effort to maintain the correct value of current when the circuit is open. When a spot is wanted and current starts to flow, the first half cycle will start early, giving full heat for at least one half cycle and maybe more, depending on the speed of the regulator. This excess current at the beginning of the weld is disastrous to the work and the electrodes.

To overcome this problem, the regulating element is energized from a standby source adjusted to the current desired. The first half cycle is either approximately correct or it can be purposely suppressed so as to start at a slightly lower than normal current. When current starts to flow, the regulating element is transferred from the standby source to the current transformer and regulates the current for the rest of the current-conducting interval.

An emission-limited tube is used in order to get a true measure of the root mean square current with various form factors that are present in phase control circuits. The filament of this tube is heated from the current transformer, and the plate current that will flow is a true measure of the heating value of the current in the current transformer. The regulating circuit is arranged to maintain constant current in the filament, and the value of line current is controlled by changing the ratio between the filament current and the primary of the current transformer.

The control described is a true current regulator that will maintain a constant current in the primary of the welding transformer while the welding machine current or the line voltage varies. It must be remembered, however, that the best the control can do is to advance the phase to a full sine wave or to retard it to approximately 20% of the current value. If wide variations are to be encountered, the normal operating point must therefore be chosen very carefully.



Current regulating compensator for use with thyratron resistance welding control. This compensates for variations in line voltage and for the amount of magnetic material in the throat of the welding machine.

Voltage Control

Where voltage variations are the main source of welding troubles, a somewhat simpler control can be used, one that will vary the phase angle of the control from the normal setting in accordance with the line voltage. High voltage will retard the firing point, and low voltage will advance it. This comparatively simple device is somewhat complicated by the fact that the angle necessary to correct for a given voltage change varies with the position of the heat control. For this reason, a sensitivity control must be ganged with the conventional heat control in order to inject the right amount of correction for the different heat settings.

Postweld Tempering

The welding of air hardening steels calls for tempering of the weld so as to restore the weld's toughness.† This tempering is done immediately after making the weld by passing a reduced current through the spot for a length of time sufficient to raise the temperature to the annealing point. Welding engineers and metallurgists should specify the required procedure to make the weld and to anneal the work so that the control designer may provide for the correct sequence of heat and cooling time.

The flexibility of phase control allows an almost infinite number of possibilities from which the metallurgist may draw. It is possible to change the current gradually from one value to another during a current conduction. In this way, the control engineer makes available to the metallurgist any cycle of conditions that the latter may desire in order to handle properly the particular alloy being welded.

Reducing Kva Demand

Some operating figures indicate that a spot weld costs only 1/10 as much as a rivet. Hence spot welding results in substantial savings in labor, material and time—all very important factors in the war of production. Little wonder that there has been a great increase in the number of welding machines used in established factories! On the negative side, however, a large spot welding machine (especially when designed for welding aluminum alloys) has a low power factor coupled with a high demand. A number of such machines operating in the same plant thus tend to disrupt the plant's voltage stability—one welder may even interfere with another welder on the same line.

Troubles from this source have been reduced by the development of power factor corrective methods. Power factor correction with series capacitors was described a few years ago by L. G. Levoy of this company**. Many installations have been made since then, and the results have been all that could be expected.

Line drop difficulties have been reduced by the use of welding controls designed to operate at 2,300 volts. The operation of welders directly from the 2,300-volt line does not reduce the kva demand, but it does reduce the line current and therefore makes the power distribution problem simpler.

As pointed out earlier, voltage stability is inherent in energy storage welding. This method helps lighten the burden on power lines by both reducing kva demand and by dividing the load over three phases.

†See "The Spot Welding of N-A-X High Tensile Steel" by C. R. Schroder, November and December, 1942, issues of THE WELDING ENGINEER.

**"Power Factor Correction of Resistance Welding Machines by Series Capacitors" by L. G. Levoy, Jr., AIEE Technical Paper 40-11, Dec. 1939.

STARVING *in the midst of* PLENTY ?

To listen to most folks, you'd think America was starving. There is plenty to eat. The fighting men must be fed. So we, at home, get less coffee, sugar and butter. That may help some of us in industry appreciate why we can't get all the *materials* we would like.

In the matter of Welding Electrodes, for example, there never was a time when anything that approached today's production poured forth. That goes for PAGE, too, where tremendous volume of electrodes for welding Stainless Steel and Armor have swelled the total. *But fighting equipment comes first*, as PAGE still sees it.

So we continue to suggest you make it a daily *must* to see that the best welding practices are followed. See that welders have the most economical electrodes for the job, that no excess metal is deposited in the weld, that every bit of every electrode is used.

PAGE WELDING ELECTRODES

PAGE STEEL AND WIRE DIVISION

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ESSENTIAL PRODUCTS . . . TRU-LAY Aircraft, Automotive, and Industrial Controls, TRU-LOC Aircraft Terminals, AMERICAN CABLE Wire Rope, TRU-STOP Brakes, AMERICAN Chain, WEED Tire Chains, ACCO Malleable Castings, CAMPBELL Cutting Machines, FORD Hoists, Trolleys, HAZARD Wire Rope, Yacht Rigging, MANLEY Auto Service Equipment, OWEN Springs, PAGE Fence, Shaped Wire, Welding Wire, READING-PRATT & CADY Valves, READING Electric Steel Castings, WRIGHT Hoists, Cranes, Presses . . . *In Business for Your Safety*

On the Job

Giant's Elbow

IT WOULD be a giant indeed who had such an elbow as the one shown in the picture below. Now in production at Tube Turns, Inc., Louisville, Ky., these 30 in. seamless welding elbows—said to be the largest ever made—are to be used in seagoing floating drydocks for the U. S. Navy.

The grand-daddy of all welding fittings is this 30 in. ID welding elbow for use on enormous floating drydocks now being constructed by the U. S. Navy. A baby turn, a half-incher, is held up for comparison.

The drydocks, likewise, will be another "world's largest." These mammoth floating structures, capable of floating a 35,000 ton battleship, will follow the fleet to battle areas under their own power.

A floating drydock is essentially a huge hollow platform that is submerged under the ship to be serviced and then raised until the ship is no longer afloat and below-the-water-line repairs can be made. Submergence, of course, is caused by letting in water, and buoyancy is regained by pumping it out again—in this case through the 30 in. welded pipe lines made with ells like the one pictured.

By using welded construction, the Navy saves erection time, saves weight and obtains for its drydocks the same superior piping that the newer fighting ships now have. This piping has exactly the same aperture around the curves (turns) that it has on the straightaways, providing maximum flow and efficiency. Maintenance, moreover, is practically eliminated as the welds are stronger than the pipe walls. Even vibrations from bombings will not affect them.

Though the walls of the grand-daddy size elbow are no thicker than those of the pipe, the forged fitting is of stronger, better steel capable of withstanding the extra strains to which the turns of piping are subjected. Accurately machined, such fittings facilitate exact alignment and perfect welding.

Flame-Hardening Big Rolls

THE extreme difficulty of obtaining replacement parts today accentuates the serviceability of flame-hardening in extending the life of surfaces subject to surface wear. A typical example is provided by a manufacturer of conveyors and foundry equipment who recently adapted flame-hardening for the hardening of trunnion rolls, 33 in. in diam, forming the bases of large dryers.

These rolls are made of SAE 1040 to 1050 cast steel, which, after a period of service, would develop flat spots that would normally necessitate the replacement of the roll. To extend the life of the wearing surfaces, a special flame-hardening technique was developed in coöperation with engineers of the Air Reduction Co.

A special machine was constructed to rotate the rolls at a slow surface speed (5¾ in. per minute) past the row of flames provided by a torch tip 3 in. wide. Since the rolls have a 10 in. face, the hardening was done in three passes.

Stationary water quenching jets were affixed to the left side of the torch and across the full width of the roll face. As each pass neared completion, an auxiliary quench was applied to the area already hardened in order to prevent drawing.

The degree of hardness obtained averaged from 500 to 600 Brinell, with an estimated depth of $\frac{3}{16}$ in. Hardnesses were somewhat lower in the narrow areas between the three hardened bands, but this was of no consequence for the particular application Sixteen rolls were hardened by this method, using a total of 4,000 cu ft of oxygen and 3,640 cu ft of acetylene.

C. O. Bartlett & Snow Co., Cleveland.

Flame-hardening a trunnion roll 33 in. in diameter and having a 10 in. face. These rolls will form the bases of large dryers.

Atomic-Hydrogen Welding

HIGH temperature atomic-hydrogen arc welding is speeding the fabrication of high altitude airplane equipment. According to R. F. Wyer, welding application engineer of the General Electric Co., this process is now being used for oxygen containers, hollow propeller blades and superchargers.

An oxygen container must be extremely lightweight, yet strong enough to withstand a pressure of 400 psi. Fabricating hollow propeller blades presents a similiar problem. Though atomic-hydrogen arc welding is not the only welding process being used in joining thin sheet metal in blade manufacture, it was demonstrated in one operation to be one third faster than the next fastest welding method.

Using the atomic-hydrogen flame for fabrication of a stainless steel nozzle box for an airplane turbosupercharger.

The third important contribution of atomic-hydrogen to high altitude flying is the joining of light gauge sections of stainless steel (always difficult to weld) in the production of superchargers. The shortage of skilled labor renders the atomic-hydrogen process particularly valuable for this use because relatively inexperienced operators are able to produce welds of uniform quality.

Atomic-hydrogen welding differs from the ordinary arc welding process in two principal respects: (1) the arc is maintained between two tungsten electrodes instead of between one electrode and the work and (2) a stream of hydrogen gas is employed to exclude the oxygen which ordinarily combines with molten metal to form oxide impurities. Hence the deposit is uniform, dense and free from pinholes.

Under the intense heat of the arc, the hydrogen breaks down from the molecular into the atomic state, absorbing large quantities of heat. As the hydrogen recombines and is consumed, it liberates this additional heat, thereby augmenting the heat of the arc for welding. This change, the breaking down of ordinary hydrogen into the atomic state, gives the process its name of atomic-hydrogen arc welding

This spot welder was converted for incandescent brazing by the attachment of brazing tongs. The brazing is done between two carbon electrodes, using a strip of silver solder.

Incandescent Brazing

SPOT WELDERS previously used for refrigerator unit manufacture at General Electric's Schenectady works were adapted for incandescent brazing. This was done by replacing the standard spot welding electrodes with dummy copper electrodes, drilled and tapped at one end for copper fittings attached to the water-cooling supply and return. To these copper blocks were connected large leads (183,000 circular mils) for plier-type brazing tongs. The leads were made 10 ft in length so that brazing operations could be performed within a 10 ft radius of the table. Both leads and tongs were water cooled.

The accompanying picture shows the table set up with blocks to braze a Y-shaped lead to a flat strip of copper. The two horizontal blocks hold the copper strip, one end of which rests on the lower carbon electrode. The Y-lead is inserted in the slotted block, a silver solder strip is placed between the two pieces of copper, and the top carbon electrode is forced downward against the copper to complete the braze.

A wooden handle is used to close the jaws of the tongs by hand. Power is applied by means of a foot switch, and a special switch was installed in the controller box to provide the continuous flow of power necessary for incandescent brazing.

Using Larger Electrodes

A DEMONSTRATION of the savings effected by switching to larger size electrodes was embodied in a recent report to the Lincoln Electric Co. from The Baker Mfg. Co., Springfield, Ill. By increasing electrode sizes from $\frac{3}{16}$ in. to $\frac{1}{4}$ in., the Illinois concern markedly reduced the welding time on the fabrication of bulldozer frames.

The effects of electrode size on consumption and deposition and on welding costs are shown in the following table:

	3/16 in.	¼ in.
Amperes	150	250
Arc volts	26	30
Kw at arc	3.9	7.5
Consumption rate, lb per hr	3.95	7.5
Deposit, lb per hr (50% operating factor)	1.32	2.5
Efficiency of set	51%	55%
Kilowatt input	7.65	13.65
Interruptions per lb consumed	8	5
Costs per Lb Deposited		
Labor	$0.758	$0.400
Overhead	0.758	0.400
Power	0.058	0.055
Electrode	0.098	0.098
Cost of interruption	0.022	0.014
TOTAL	$1.694	$0.967

Note that the use of ¼ in. electrodes reduced the cost per lb deposited by $0.727 or 43%, due to such factors as boosting the deposit from 1.32 to 2.5 lb per hr.

» «

Cutting Tank Sprockets

THE accompanying illustration shows four torches simultaneously cutting tank tread sprockets from one strip of steel plate. An unlimited variety of shapes from steel plates, slabs, billets and forgings may be cut with this type of flame-cutting machine, which operates on the pantograph principle so that one or several cutting torches are made to conform exactly to the movement of a tracing device.

Courtesy, Lukens Steel Co.

Speeding up tank production! The cutting of four tank sprockets at once represents only one of the many applications which have been found for flame-cutting in the war effort.

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WHY THE MAJORITY OF UNIONMELT USERS PREFER

Westinghouse A-C Welders

1. Westinghouse transformer equipment is specially designed for use with the Unionmelt welding head.
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3. Built-in power-factor correction reduces power demands.
4. Single pre-set current control speeds adjustment—simplifies operation.
5. Natural air cooling eliminates fans.

The Unionmelt Welding Process is the fastest known method of making butt, fillet, and plug welds—up to 20 times faster than any other method. Working together, Unionmelt equipment and Westinghouse A-C Welders form a team that will give you faster continuous production at a new low cost. Write for full details—ask for Booklet B-3090. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pennsylvania. J-90470

* Unionmelt is the registered trade-mark of The Linde Air Products Co.

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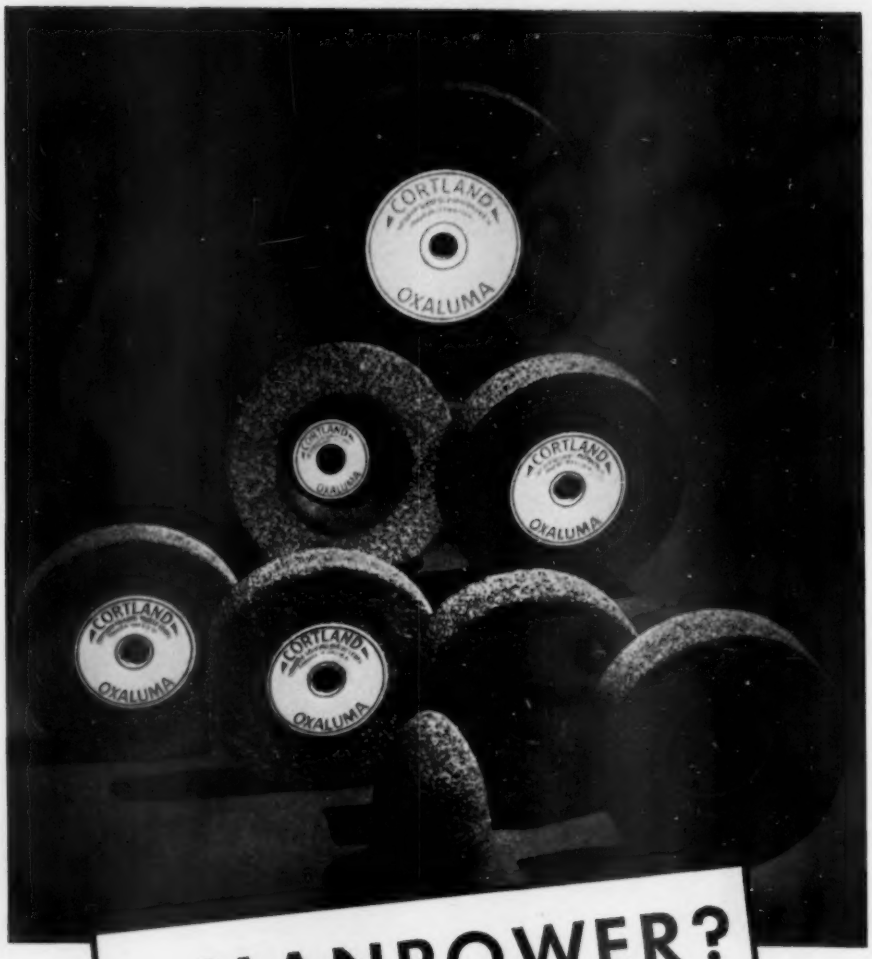


- MANPOWER?
+ WHEELPOWER!

Cortland Engineers have been able to show better performance in many cases where *man and wheel* were both satisfactory. It stands to reason, therefore, that Cortland can help you in the present manpower shortage, when green hands must be given wheels fitted to the job. Inquiries handled promptly.

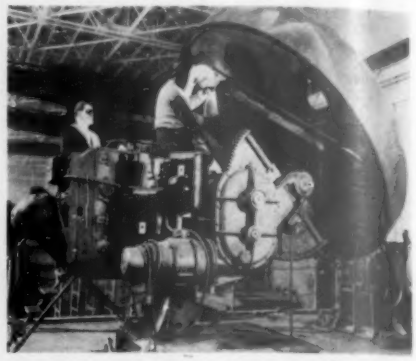
10

Snagging Wheels by
CORTLAND

CORTLAND GRINDING WHEELS CORP. • CHESTER, MASSACHUSETTS

Fabricating Marine Gears

THE immense physical size of marine propulsion gearing is almost unbelievable to the uninitiated. A second reduction or "bull" gear for a ship developing 8,500 shaft-horsepower, for example, is 146 in. in diameter—approximately twice the height of a tall man. Its two helices are each 18½ in. wide and are separated approximately 24 in. The extremities of the teeth are over 60 in. apart.



Welding a large marine gear blank. Welded fabrication has greatly reduced weight of turbine gears at the Westinghouse merchant marine plant.

Though the cutting or hobbing of such a gear is the major problem of manufacture, the fabrication of the gear blank is in itself a task of no mean order. For this job, welding is used, as shown in the accompanying picture taken at the Westinghouse merchant marine plant. An electrically controlled positioner turns the work so that all welding can be done in the economical and efficient downhand position.

The gear hobbers which generate the teeth of these big marine gear units are marvels of accuracy. The hob does not vary by 0.0002 in. to or from the table throughout the entire face of the gear to be hobbed. Even this perfection, however, is not sufficient safeguard for accuracy as a 146 in. gear will expand 0.009 in. in diam with a temperature change of only 10 F. Hence each hobbing machine has to be enclosed in an air conditioned room and the temperature maintained between 68 and 70 F.

Inaccuracies, if allowed, would result in pitting of the overloaded tooth face, noise and in extreme cases tooth breakage.

» «

WPB Award

HARRY Stewart, an employee of the Caterpillar Tractor Co., Peoria, Ill., received a recent WPB award for a change in the method of manufacture of a track roller frame assembly. Stewart's suggestion saves 120 lb of electrodes and 400 man-hours per year.

The welded assembly of the track roller frame consists of two long channel sections held together with welded cross braces. These cross braces were made with a ½ in. 45 deg chamfer on the edge adjacent to the channel. The weldor had to fill up the chamfer with weld metal before completing the welding of the brace. Stewart's suggestion was to eliminate the chamfer from the cross brace, which, he proved would not only save electrodes but result in a better welding job.

Credit quick BRONZE WELDING with two more outstanding repair jobs

(Left) A 14-ton ram—badly fractured—but put back into service in only 6 days . . . with 1750 lbs. of Tobin Bronze. (Right) A 2-ton section of a boring mill—cracked in four places . . . Anaconda "997" Low Fuming Rod made it as good as new—with only 39 man hours for chipping and welding.

Day by day, a lot of money is being saved in both time and vital equipment by repair welding with Anaconda Rods such as Tobin Bronze* and "997" Low Fuming. The availability of this fast, efficient method of repair gives war industries a potent aid in keeping up production. For information on welding with Tobin Bronze and 15 other Anaconda Rods, write us for Publication B-13. You'll find it especially useful at this time when prolonged equipment life is so important. 4385

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Anaconda Welding Rods

ANACONDA

Saving a Steam Turbine

A steam turbine in a destroyer engine room developed a crack which, though of almost microscopic size, could have caused a fountain of live steam at 600 lb. It was repaired by welding.

By **JOSEPH SCHUMAN**
Weldor, New York Navy Yard

"JOE, I have a particular job for you." My supervisor pointed to a steam turbine in the engine room of a destroyer and said, "There is a leak in this steel casting."

The crack was so small that I couldn't even see it at first. "It doesn't begin to leak until the steam pressure passes 150 lb," he explained, "but by the time the pressure reaches 600 lb the steam is sprouting from the crack like a fountain. In making the repair, we must be careful that the crack does not spread. Also, the crack is right at the seat of a valve. If your welding should penetrate below the inside face of the casting, the valve will be damaged, and then there will have to be a complete overhaul of the turbine."

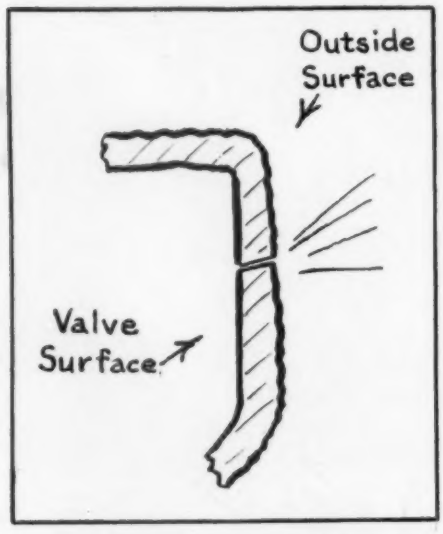


Fig. 1—Cross-section of cracked turbine wall. The thickness of the wall at the crack was checked from blue prints before grinding.

It sounded like a tough assignment —and it was!

First, we had to check the thickness of the metal at the point of the crack, Fig. 1. To do this, we called in the machinists, who secured a blueprint of the turbine. They found that the metal at this point was not as thick as we had guessed. If we had proceeded to grind away the cracked metal without checking, we would have ground right through the valve.

The metal about the crack was ground away, Fig. 2, using a small conical stone. We watched this operation closely and told the grinder to stop when he had taken away as much metal as we thought safe.

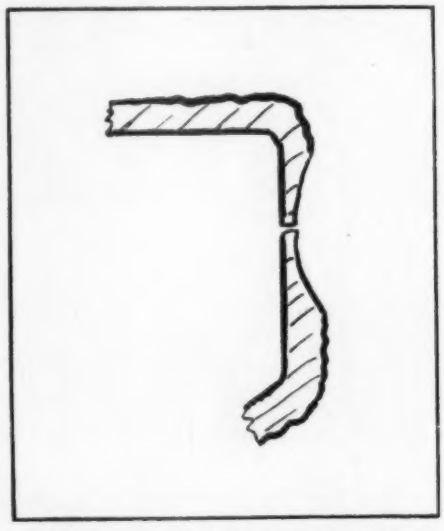


Fig. 2—The metal about the crack was ground away in preparation for welding.

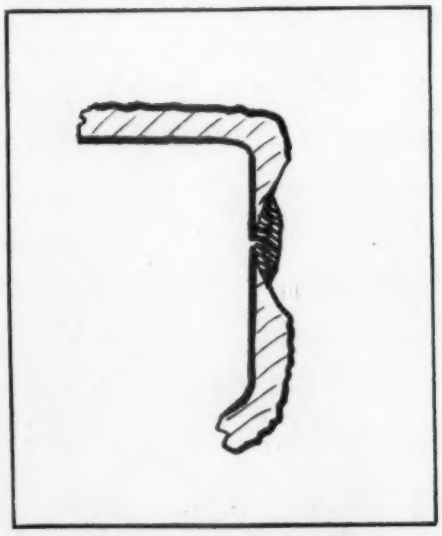


Fig. 3—The casting was preheated by allowing steam to enter the turbine. The first welded bead sealed the crack as shown here.

Preheating with Steam

The next problem was to preheat the steel casting. An acetylene torch was the first suggestion, but a better method soon came to mind, and we had the sailors let steam into the turbine. This thoroughly preheated the entire steel casting, though, admittedly, it is a method which is probably unique to this particular type of repair.

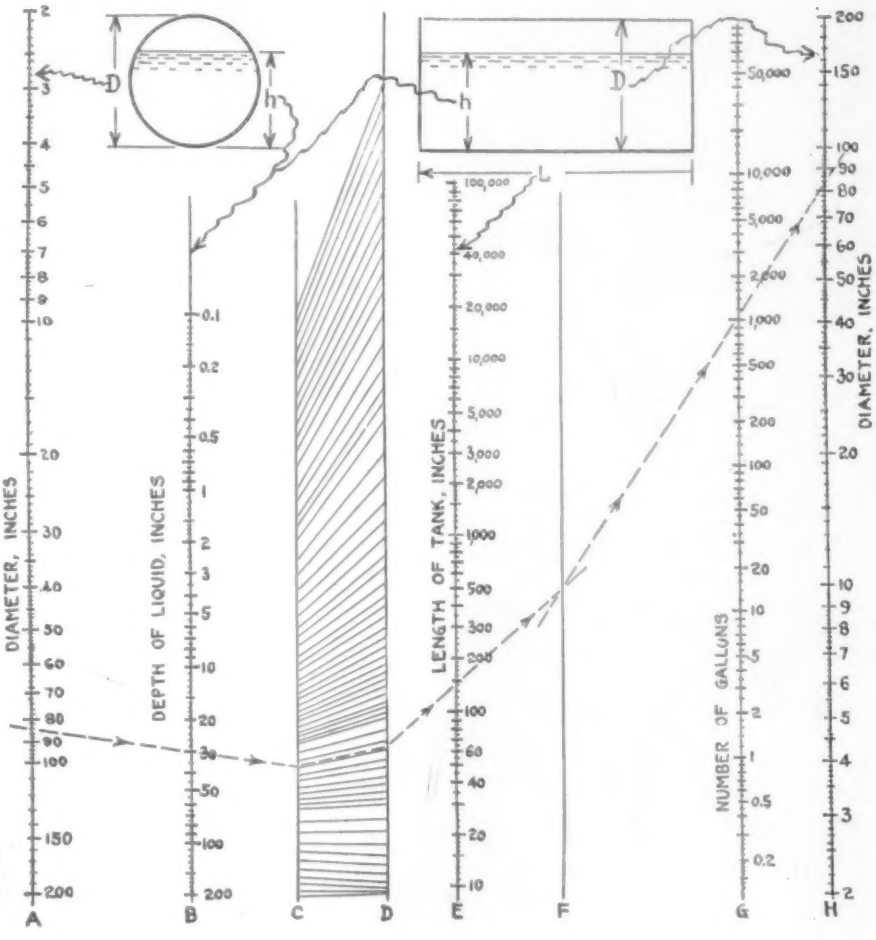
After the steam had been shut off, welding was begun, using a 1/8 in. carbon-moly steel electrode. A small layer of metal was deposited over the crack, Fig. 3; this layer was immediately peened lightly with an air-operated peening tool. The second and third layers were likewise peened, but the fourth and final layer, Fig. 4, was not. It was allowed to remain as deposited except for the removal of slag.

Fig. 4—Three more layers of metal were deposited in order to finish the job.

The weld was allowed to cool for about twenty minutes, and then the turbine was tested with the full 600 lb pressure. The crack was sealed, and the turbine operated perfectly.

Horizontal Tank Capacities

By W. F. SCHAPHORST, M.E.



ALTHOUGH horizontal tank capacities are commonly regarded as difficult to compute, the accompanying alignment and chart makes it easy to determine the gallons of liquid in any horizontal tank without the use of tables, formulas, figures or computations of any kind. For example: How many gallons in a tank 84 in., the depth of liquid being 30 in. and the length of the tank being 142 in.? The answer is found immediately in column G through the following simple operations:

First, lay a straight edge through 84, column A, and 30, column B, locating the insertion with column C. Follow the radiating "guide lines" to Column D, locating a second point of intersection. Extend a line from the latter intersection to 142, column E, establishing a point of intersection on column F. From this point project a line to 84, column H, and the answer will then be found in column G. It is approximately 1,050 gal.

To eliminate the possibility of mistakes, sketches have been included at the top of the alignment chart. These show the diameter of the tank as D, the depth of liquid as *h*, and the length of tank as L, with wavy arrows leading from each to the proper column.

An important advantage of this chart is that it takes care of any depth of liquid from 1/10 in. to the full capacity of the tank. Likewise, the range of the chart is amply wide since it is suited for any diameter from 2 to 200 in., and any length from 10 to 100,000 in. All dimensions are given in inches to avoid confusion.

Since column E takes care of lengths of tanks up to 100,000 in., which is equal to 8,333-1/3 ft., it is plain that this chart will not only compute tanks, but it will also include long pipes wherever it is desired to compute either the full capacity of such pipes or their partial capacity.

Inversely, the chart may be conveniently used for determining the length of tank necessary to hold a given number of gallons where the diameter of tank and depth of liquid are known or are fixed quantities as is often the case. The method of applying the chart to problems of this character is so obvious that further directions are deemed unnecessary.

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The Technical Slant

Books are the ever-burning lamps of accumulated wisdom—*G. W. Curtis.*

Plant Protection

INDUSTRIAL GUARDS MANUAL. *By Harry D. Farren. Published by National Foremen's Institute, Inc., Deep River, Conn., 1942. Cloth, 5 x 8 in., 96 pages. Price $1.25.*

This brief book of eight chapters includes most of the information that might be classed in the category of "what an industrial guard should know."

The opening chapter discusses public and worker contact, pointing out the importance of the guard's duties and means for handling the public and the worker. In the second chapter are given many important pointers on mob psychology and what to do in the case of riots and panic. The next three chapters deal with topics of general interest to everyone: self-protection, first aid and fire protection.

So far as the industrial guard is concerned, the three concluding chapters of the book are probably the most important. They deal with sabotage and espionage, plant protection and bombs and infernal machines. The last-mentioned chapter, though brief, goes into considerable detail as to how to handle bombs, information regarding air raids, incendiaries and air raid shelters. Some excellent pointers are given on how to fight the fires which have been started by incendiary bombs.

» «

INDUSTRIAL FIRE BRIGADES. *By N.F.P.A. Committee on Firemen's Training. Published by National Fire Protection Association, Boston, 1943. Paper, 8½ x 11 in., 184 pages. Price $1.50.*

This excellent training manual is designed to meet three needs: first, as a training manual for employees assigned to fire fighting duties under the direction of a fire brigade chief; second, as a reference book in those plants that have an organized fire brigade but where the experience of a large group of experts would be profitably utilized; third, as a text in those plants which need the essentials but not the details of a large plant fire protection organization.

Pointing out that the fire brigade is possibly the most important part of the fire safety organization, the manual tells the members of one what to do when a fire occurs as well as what each of them must know before a fire occurs. Department heads, it is emphasized must be responsible for seeing that employees know how to prevent fires and how to use fire extinguishers, hand hose and other first aid fire appliances. However, it is up to the manager of the plant to arrange for the organization of a plant fire brigade.

The 16 chapters of this book cover all phases of the industrial fire brigade from its organization training to fire fighting tactics and rescue work. All things considered, *Industrial Fire Brigades* is a very complete training manual.

» «

Resistance Welding

RESISTANCE WELDING MANUAL. *Published by Resistance Welder Manufacturers Association, Philadelphia, 1942. Simulated leather, 6 x 9 in., 286 pages. Price $2.50.*

This is the first book devoted exclusively to resistance welding to come to this reviewer's attention in recent years. The text, previously published as six chapters in the *Welding Handbook,* pertains entirely to the various phases of resistance welding, and it is presented in this convenient form for those whose interest lies wholly within this field.

The opening chapter, a discussion of the fundamentals of resistance welding, goes into the general theories of resistance welding and its economies as well as electrical and mechanical characteristics and power supply for resistance welders in general.

Under a chapter headed "Resistance Welding Processes," detailed information is presented on spot, projection, seam, flash and upset butt welding processes. Special welding processes such as projection, stored energy welding, etc., are also included. In subsequent chapters, resistance welding machines are discussed from installation and servicing angles. A chapter on controls covers A-C controls, time and pressure controls, sequence and measurement controls. This discussion is followed by a chapter on electrodes and electrode holders and conductors. The book closes with a chapter on definitions and symbols.

This manual fills a recognized need for an accurate, practical and comprehensive reference on resistance welding.

Machine Shop

MACHINE SPEEDS AND FEEDS. *Compiled by Howard Tyler and Co., Ltd. Published by Chemical Publishing Co., Brooklyn, N. Y., 1942. Cloth, 4½ x 6½ in., 131 pages. Price $2.25.*

This manual has been prepared as a guide for the use of the wartime apprentice who, because of short training courses, needs guidance in the selection of proper speeds and feeds for machining metal.

The information is presented in the form of a number of tables and data sheets relating to machine operations on cast iron, steels and non-ferrous materials using high-speed tools. There are also 19 tool form charts. The tables are grouped by machines so that the information required for a specific type of machine will be in a convenient form for quick reference.

The data given on speeds and feeds are not the highest figures possible but more nearly strike an average. However, these figures will produce reliable results, even when starting a job. Naturally, the values can be increased, depending upon the experience of the operator, operating conditions and production demands.

» «

Electrical

ELECTRICAL AND RADIO DICTIONARY, SECOND EDITION. *By Carl H. Dunlap and Enno R. Hahn. Published by American Technical Society, Chicago, 1943. Cloth, 5½ x 8½ in., 110 pages. Price $1.00.*

As the name implies, this volume is a dictionary of radio and electrical terms. The definitions are in an easy-to-understand language, which makes the book an excellent reference work for one studying or working in electricity or radio. Besides the definitions of electrical and radio terms, the book contains several pages of symbol drawings with a picture of the objects the symbol represents opposite each drawing. Also included are several motor and starter diagrams, numerous electrical formulas and handy tables relating to energy torque, power, etc.

The volume closes with an explanation of the National Electric Code Standards, including tables for copper wire, motor starting wire, temperature conversion tables and a table of decimal equivalents.

New Products to Use

Electrode Holder

★ A new holder designed to eliminate electrode waste is the Wells **"Suregrip" Rod Saver.** This holder is featured by a screw-type of grip that exerts a positive

Wells "Suregrip" Rod Saver electrode holder. It has a positive grip, is streamlined and fully insulated.

clamping action upon the uncoated portion of the electrode and will permit the electrode to be burned to an extremely short stub. Electrodes can be changed almost instantly with a twist of the wrist.

Two other new features of the holder are also important: the maximum diameter of 1⅞ in. allows the holder to go through small holes without disassembly, and it is fully insulated throughout. The insulation is provided by snap-on insulators, which can be replaced on the job and will stay in place permanently without screws. The holder, manufacturer states, can be laid anywhere without arcing if these insulators are used.

The holder has an overall length of 10½ in. and is said to be extremely lightweight for the amperage it carries. In the handle, 28 large openings permit the free circulation of air and reduce by 50% the surface in contact with the weldor's glove. **Martin Wells,** 5886 Compton Ave., Los Angeles.

» «

Flow Switch

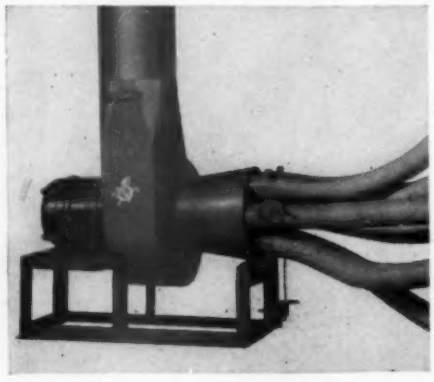
★ An electro-thermostatic flow switch to detect any lack of the cooling water required for ignition tubes is announced by Westinghouse for resistance welding and other applications. The switch consists of a 100 watt transformer having a one-turn secondary that is short circuited through a piece of high resistance stainless steel tubing through which flows the water from the ignitron tubes. A normally closed two-pole thermostatic switch is used. Further information may be secured from Dept. 7-N-20, **Westinghouse Electric and Mfg. Co.,** East Pittsburgh, Pa.

Plastic Drill

★ A ¼ in. portable electric drill with grip handle, field case and gear case constructed of a tough, lightweight

Thor plastic-encased drill. Formerly produced only for the Army, it has now been made available to all war industries.

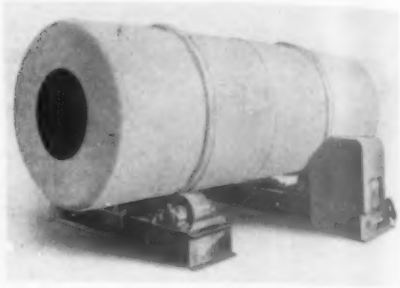
plastic is now announced for general war production purposes by the **Independent Pneumatic Tool Co.,** 600 West Jackson Blvd., Chicago. The company has been producing large quantities of this drill for nearly a year under an Army contract. It is available in three speeds: 2,500, 3,750 and 5,000 rpm.



Chelsea blower. A portable unit for the removal of fumes from shipholds and other confined spaces.

Fume Exhauster

★ This newly developed centrifugal-type blower can be used in shipholds, welding rooms, tunnels, vaults, basements, etc., either for the removal of fumes or the drawing in of fresh air from outside. The unit has been so designed that the fumes, gases, dust, filings, grinding compounds, etc. do not come into contact with the motor. Blower wheel is made of ⅛ in. steel thickness and motor has been tested to an overload capacity to insure its ability to meet the rough usages to which a blower of this type is subjected. The adapters are interchangeable and can be used for suction or blowing as desired. **Chelsea Fan & Blower Co.,** Inc., 1206 Grove Street, Irvington, N. J.



Ransome turning roll set for position welding of tanks and other large cylindrical work.

Positioner for Cylinders

★ Position welding of long drums, tanks and other heavy cylindrical pieces may be facilitated by the new **Ransome turning roll set,** which is now available for handling loads up to 75 tons. The set consists of a pair of motor-driven rolls controlled through a variable-speed unit that permits selection of the speeds suited for individual job requirements. A remote push button control for forward or reverse rotation is also included. The center to center distance of the rollers may be changed for handling work ranging from 2 to 14 ft in diameter. One or more sets of idler rolls are used, according to the length of the cylinder being welded. Industrial Div. of the **Ransome Machinery Co.,** Dunellen, N. J.

» «

Ipco welding curtains. They will shield bystanders from arc glare when welding is being done and also protect them against chips and scale when welds are being cleaned.

Welding Curtains

★ Constructed of either flameproofed and waterproofed canvas or of asbestos, **Ipco welding curtains** are designed to confine a welding operation to a particular area and thereby protect other workers or passers-by from arc glare. The curtains are furnished with a row of eyelets across the top and with two eyelets in each lower corner. The top eyelets allow for suspension on a horizontal rod or pipe support by means of hooks or cord laces, while the bottom eyelets permit attachment of a cord to pull the curtain taut. **Industrial Products Co.,** 2820 N. Fourth St., Philadelphia.

More Welding-Better Quality Welds

with the

WILSON "HONEY BEE" ARC CONTROL STATION

TWO or more "Honey Bees," connected to any constant potential arc welding generator, increases the number of welding arcs that can operate simultaneously from a single welding machine.

At the same time the "Honey Bee" assures better welds on light gauge metal – thanks to Wilson Remote Crater Control. Craters, porosity and similar defective welds are prevented because Crater Control permits the operator to fade out the arc slowly – never breaking it abruptly.

Each operator using a "Honey Bee" station has full control over his welding current. A switch conveniently held in the operator's hand enables him to regulate his current while welding to any value (from zero to maximum) within the full range of the "Honey Bee" station. Changes in current setting do not affect the performance of any other "Honey Bee" stations working from the same generator.

The Wilson "Honey Bee" is available in two sizes – 75 amps. and 150 amps. For complete details get in touch with your nearest Air Reduction sales office. A descriptive bulletin ADW-47 will be forwarded on request.

Metal deposited with standard welding machine and no crater control.

Metal deposited with Wilson "Hornet" equipped with "Honey Bee" Remote Arc and Crater Control Station.

Photo courtesy of Curtiss-Wright Corporation.

WILSON

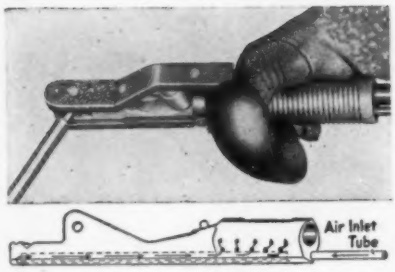
WILSON WELDER and METALS CO., INC.

General Offices: 60 East 42nd Street, New York, N. Y.

Heavy-Duty Holder

★ An air-cooled electrode holder is announced for such arc welding jobs as heavy gauge armor plate. On such jobs, electrodes as large as ½ in. may be used, and the resulting heat makes it difficult for the weldor to work. This holder is kept at a comfortable handling temperature by means of air which travels the entire length of the lower tong. An inlet tube is provided to introduce air at 3 to 4 lb pressure from the plant's air lines.

The new holder is made of high conductivity copper alloy, with deep-slotted jaws that grip the rod tightly and hold it at the proper angle for welding. A solder cable connection is provided. **Jackson Products,** 3265 Wight St., Detroit.



Cooled by air at from 3 to 4 lb pressure, this new Jackson holder should make it easier to weld armor plate. Sketch of lower tong shows air cooling feature.

» «

P & H intermittent duty A-C arc welder, Model TWI-200.

A-C Welders

★ With a view to expanding its welding equipment service to war industries, Harnischfeger Corp. announces the addition of a complete line of industrial A-C arc welders to the present line of P & H D-C welders. The new machines are being made in seven heavy duty and four intermittent duty models with a range of capacities for handling production welding under continuous operation. The line features the recently adopted "WSR" (Welding Service Range) ratings which show the actual minimum to maximum output of usable welding current. Specific "WSR" ratings of the heavy duty models are: 50 to 270 amp, 60 to 375, 90 to 500, 100 to 625, 125 to 750, 150 to 900, and 200 to 1,200. Ratings of the intermittent duty models are: 20 to 185 amp, 20 to 235, 20 to 285 and 20 to 335. Setting and current control throughout the complete welding service range involves only one easily operated adjustment.

Additional details of these new welders may be obtained by addressing the Welder Div., **Harnischfeger Corp.,** 4400 W. National Ave., Milwaukee.

» «

Carbon Electrode Holder

★ Carbon arc welding is assuming increasing importance of recent months, particularly in the aircraft field and for welding on light gauge stainless steels and other alloys. A special holder for 5/32 in. carbon electrodes has been developed by the **Tweco Products Co.,** English at Ida, Wichita, Kansas. This model, the **"Type CM Hol-Grip Jr.,"** looks from the outside exactly like manufacturer's regular "Hol-Grip Jr." but differs in that the electrode insertion holes are grooved in order to prevent carbons from breaking. The grooving, states manufacturer, does not prevent the holder from being used for metallic electrodes as well as for carbon.

Castolin Eutectic

LOW TEMPERATURE WELDING

NO RISK OF BURNING IN JOINING LIGHT TO HEAVY GAUGE

PROBLEM

To join the thin bronze mesh of these oil tank hose strainers to the thick brass frame without overheating and burning the mesh. With high temperature fusion welding such damage was prevalent. As a result vital metal and man-hours were needlessly wasted on a great number of the units produced.

SOLUTION

With Castolin Eutectic Low Temperature Welding Alloy No. 180 these strainers are being turned out in but a fraction of the time with no waste of vital metal through overheating damage. Castolin Eutectic Alloy No. 180 binds at 1290°F . . . *gives stronger, smoother, color matching joints requiring no after-machining.*

Only "Eutectic* Alloys" are the true Low Temperature Welding Alloys that are revolutionizing production welding, maintenance welding and salvaging in war plants throughout the nation. There are 42 specialized rods for every metal and every welding job. Developed and manufactured only by Eutectic Welding Alloys Company.

*Reg. U. S. Pat. Off.

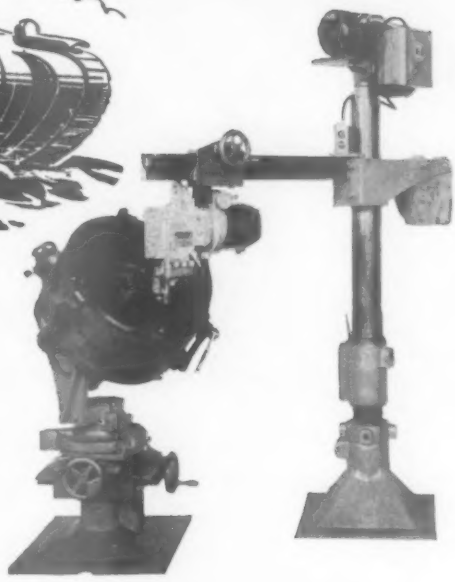
New 36 page Welding Data Book K Write Today

EUTECTIC WELDING ALLOYS COMPANY

SOLE MANUFACTURER – CASTOLIN EUTECTIC WELDING ALLOYS

40 WORTH STREET, NEW YORK, N.Y

Quicker Welding . . With This Automatic Welding Machine Fixture



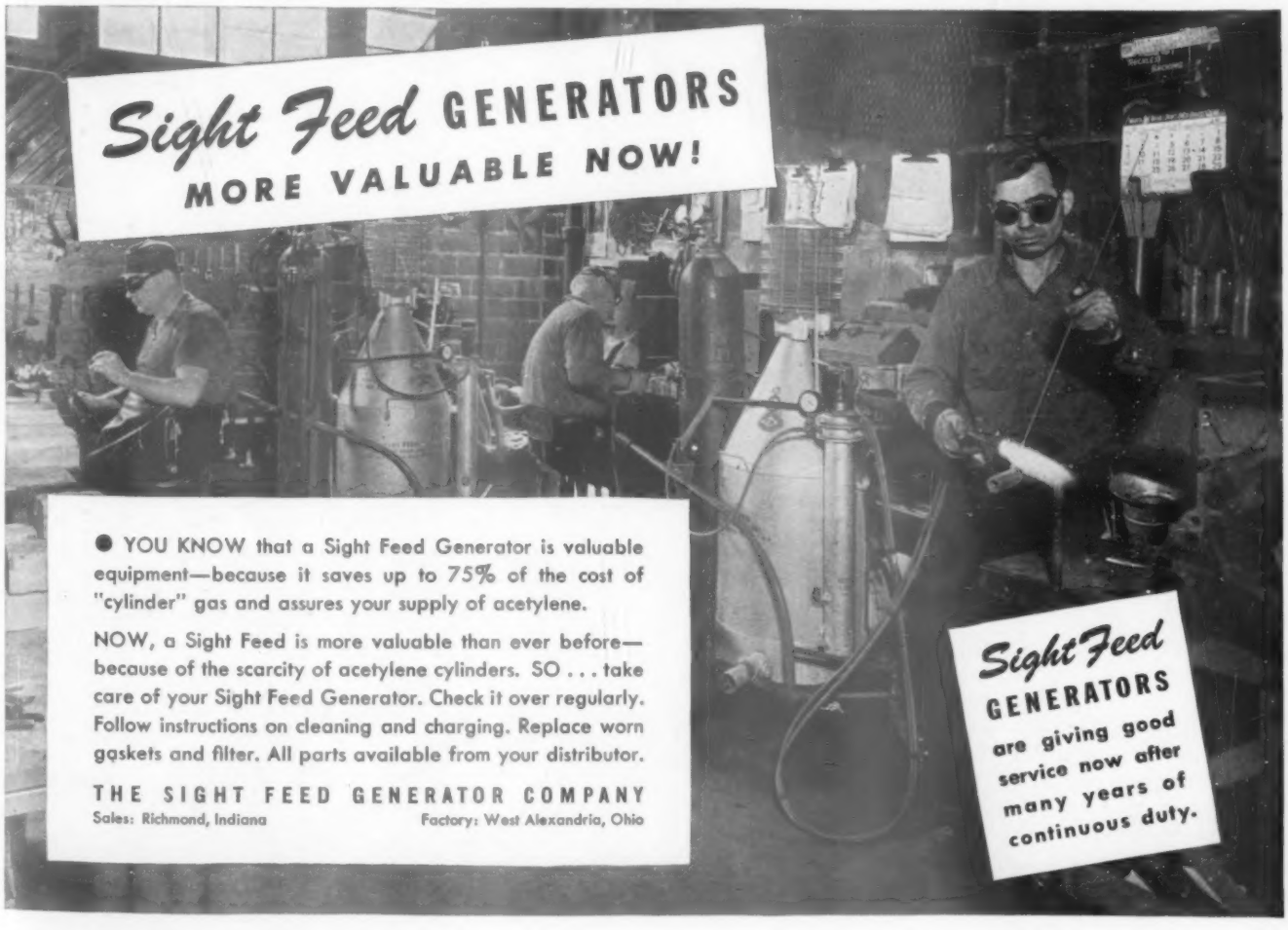
Reloading Is done During Welding Operation

THIS Acme dual fixture arrangement permits practically constant use of an automatic welding head, because one of the fixtures can be reloaded while the other is engaged in the welding operation.

The holding machine can be set to revolve at any angle from vertical to horizontal. (Illustration shows a wheel being welded at 45° angle.) Positioner arm swings from one fixture to the other, locking in proper position. Speed of rotating the work is adjustable, as desired.

ACME Manufacturing Co.
1642 HOWARD ST. • DETROIT, MICH.

WRITE
for information. Whatever your positioning problem on automatic welding, let us help you solve it. Write for complete information.


Sight Feed GENERATORS
MORE VALUABLE NOW!
● YOU KNOW that a Sight Feed Generator is valuable equipment—because it saves up to 75% of the cost of "cylinder" gas and assures your supply of acetylene.
NOW, a Sight Feed is more valuable than ever before—because of the scarcity of acetylene cylinders. SO . . . take care of your Sight Feed Generator. Check it over regularly. Follow instructions on cleaning and charging. Replace worn gaskets and filter. All parts available from your distributor.
THE SIGHT FEED GENERATOR COMPANY
Sales: Richmond, Indiana
Factory: West Alexandria, Ohio
Sight Feed GENERATORS are giving good service now after many years of continuous duty.

Protective Turban

★ Women weldors should be glad to hear of this new protective turban styled by John Frederics, noted millinery creator.

John Frederics, New York hat designer, puts the finishing touches to the American Optical Company's new fire-resisting turban to protect women weldors from flying sparks.

The turban is designed to wear underneath a welding helmet. With or without the helmet, it provides protection against flying sparks and holds the hair snugly in place. It is available in either lightweight chrome tanned leather, gray or brown, and also in pin-striped dark gray cassimere—a fire-resisting cloth. The turban is of one-piece construction and is assembled by snaps only. One size, it is stated, will fit every size of head closely enough for all practical purposes. **American Optical Co.**, Southbridge, Mass.

» «

Hard-Facing Alloy

★ **"No-Wear"** a new cemented tungsten carbide, has been developed to meet the demand for a quick, economical means of increasing the life of parts subjected to severe abrasion use. This hard-facing material has a hardness of 62-66 Rockwell C as deposited and a high degree of resistance to abrasive wear at elevated temperatures. It can be readily applied with the oxy-acetylene torch, using a carburizing flame. It does not oxidize and is not readily affected by mild acids. Its melting point of 2,372 F is slightly below the melting point of the steel base, permitting application by brazing in thin layers. One lb of "No-Wear," it is stated will cover an area of approximately 90 sq in., ⅛ in. thick. **Callite Tungsten Corp.**, 544 Thirty-ninth St., Union City, N. J.

» «

Safety Goggles

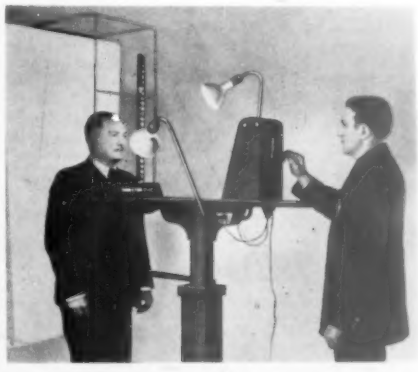
★ Weldors who are required to wear prescription glasses while working will be interested in the announcement of two new **"Overspec"** goggles which may be worn over their regular glasses. No. 5963 is a welding goggle, featured by screw cap lens retainers which permit quick replacement of lenses without the use of tools. It is equipped with 50 mm diameter "Welda" lenses, shades 4-5-6. Other features are a comparatively light weight, ample ventilation, adjustable leather nose bridge, and elastic headband.

The No. 5960 goggle is for general use by chippers, grinders and others who want eye protection from flying particles. Having the same general features as the No. 5963, it is equipped with 50 mm diameter clear "Resistal" non-shatterable lenses. **Harry Buegeleisen, Inc.**, 181-183 Pacific St., Brooklyn, N. Y.

» «

Identification Unit

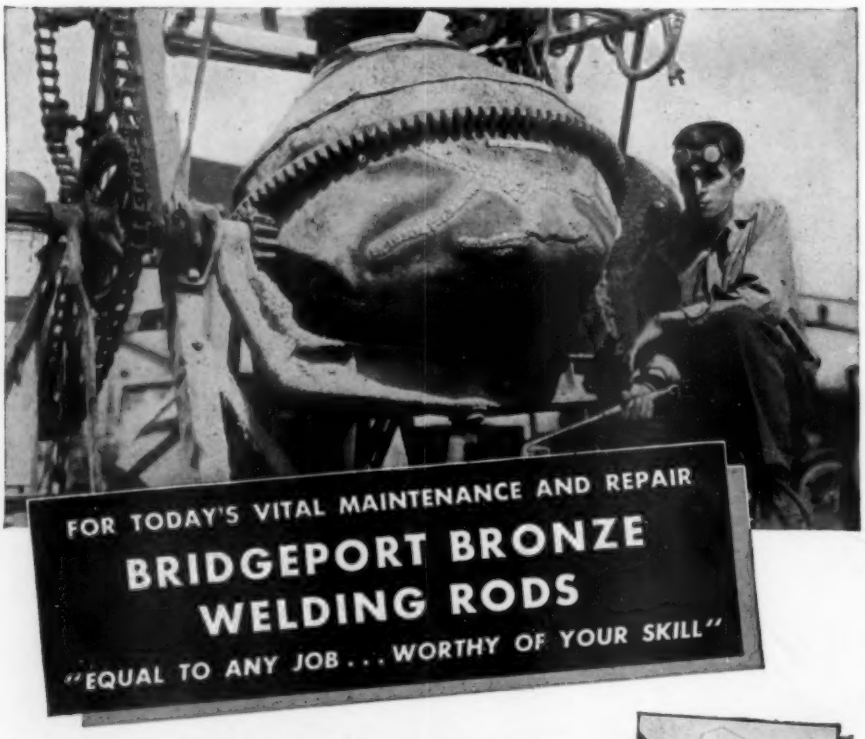
★ The **Wim Model B** photographic identification unit makes it possible for law enforcement agencies and industrial institutions to take identification pictures



Wim Model B identification unit. Note that employee's number and height are recorded on each photograph.

for employees' identification badges and pass cards at a moment's notice and even though trained personnel may not be available to operate the device. Many improvements over the former Model A have been incorporated in the new model. These include a white washable background, self-leveling easel base, increased counterweight capacity, finger-printing equipment (optional at slight additional cost) and an accurate height indicator. As many as 1,000 pictures can be taken in an eight hour day. To take a picture it is only necessary to set the identification number and push the camera button; focusing, timing and lighting have been factory adjusted for accuracy. **Photographic Equipment, Inc.**, 210 East Park Way, Pittsburgh.

Bronze welding does a timely salvage job in war plant construction equipment. Note deep "breaks" skillfully welded with Bridgeport No. 192 low-fuming bronze welding rod.



Maintenance and repair finds Bridgeport Bronze Welding Rods hard at work getting "absentee" equipment back on the job in good working order. For it is recognized that the rod selected must meet all requirements for strong, dense, tough welds. That is why the reliable, workable qualities of Bridgeport Bronze Welding Rods are selected for jobs that must be right.

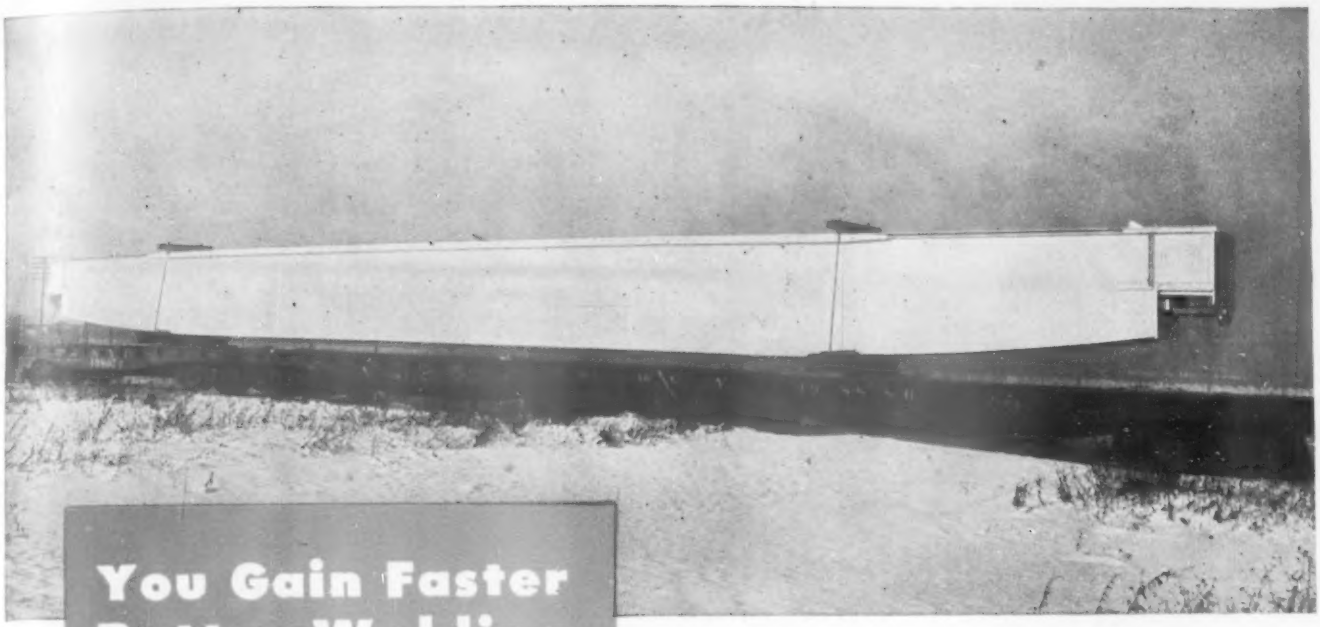
In replenishing your stock get the best by specifying "BRIDGEPORT" Bronze Welding Rods, the product of 78 years of experience in metallurgical research and development.

FACTS FOR WELDERS
...Practical, up-to-the-minute data. How to select and use bronze welding rods for best results. It is yours free by writing Bridgeport.

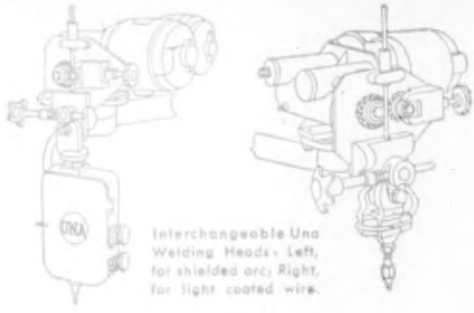
BRIDGEPORT BRASS

"Bridgeport" BRASS CO.

BRIDGEPORT BRASS COMPANY
BRIDGEPORT, CONN. • ESTABLISHED 1865



You Gain Faster Better Welding on more kinds of Work -- with UNAMATIC



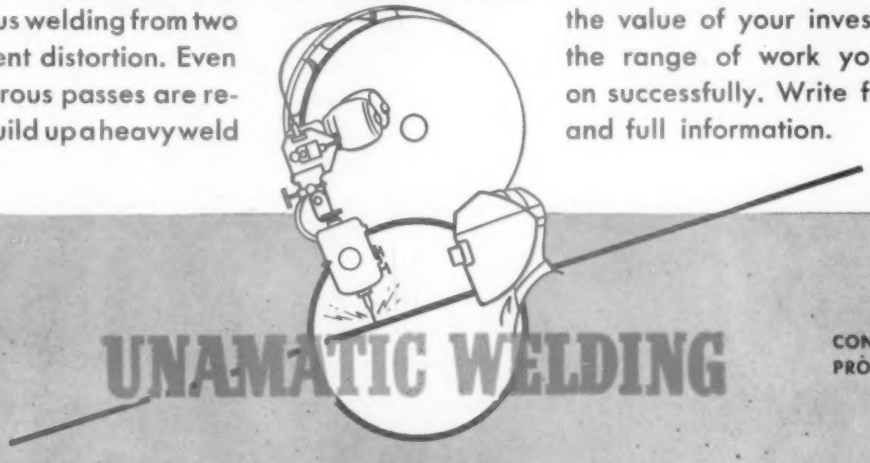
Interchangeable Una Welding Heads: Left, for shielded arc; Right, for light coated wire.

WELDING jobs like the 120-foot, 30-ton girder shown above emphasize the fact that Unamatic Welding is not merely faster but better. In many cases the 200% to 300% greater lineal speed, as compared with manual operation, is often the factor that makes a successful welding job possible.

In girder work, distortion due to heat conduction is often a real problem. Unamatic fast travel and low heat, often combined with simultaneous welding from two sides, prevent distortion. Even when numerous passes are required to build up a heavy weld there is a large net saving of time and cost.

Unamatic shielded arc welding equipment is adaptable for use with light coated wire. A simple change in the head, easily made in your own shop with elements we supply at nominal cost, enables you to convert from shielded arc to light coated at will.

When changing from manual to automatic welding this versatility of Una equipment should be kept in mind as it increases the value of your investment and the range of work you can bid on successfully. Write for catalog and full information.



CONTROLLED QUALITY

UNAMATIC WELDING

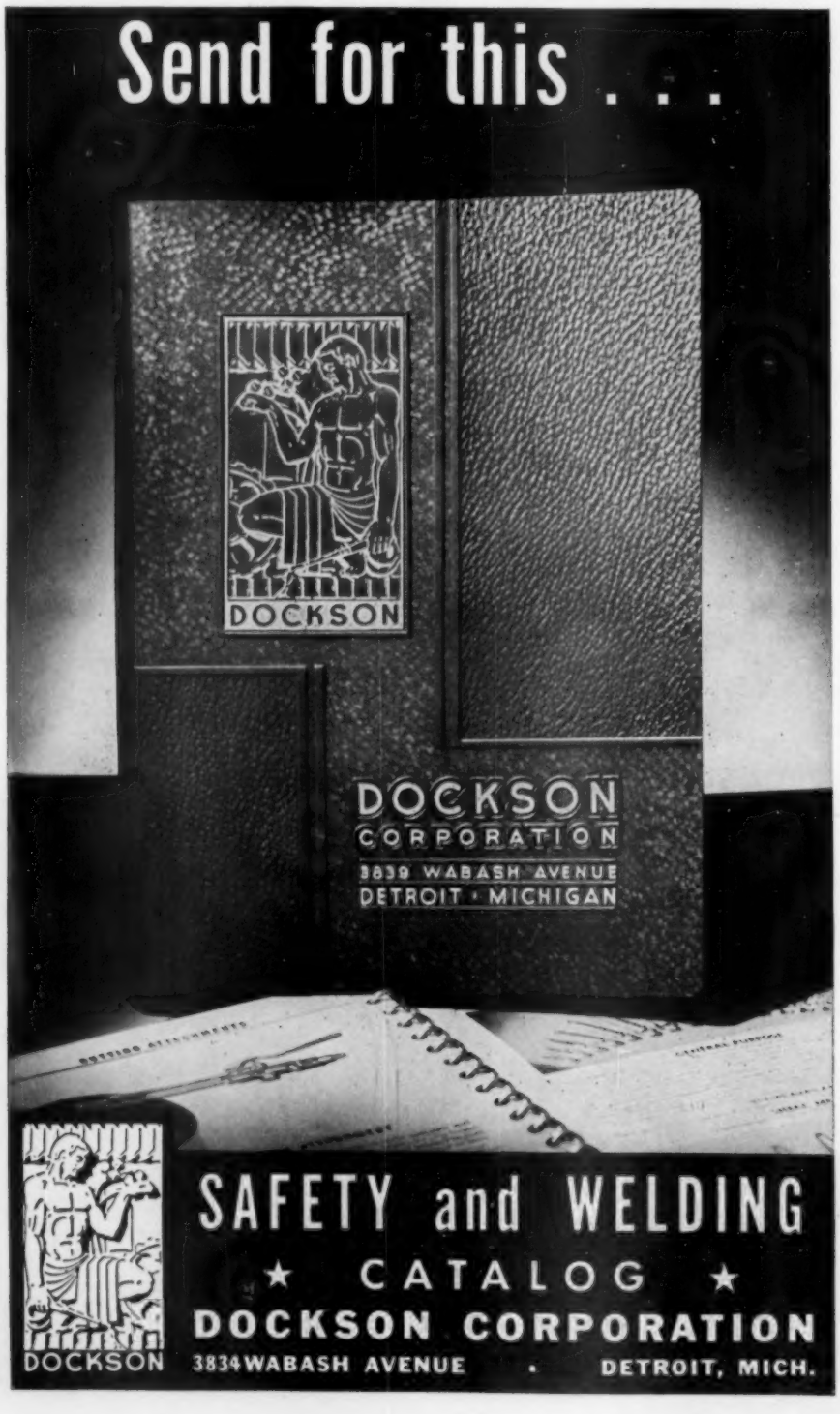
CONTINUOUS PRODUCTION

UNA WELDING INC. • 1615 COLLAMER AVE. • CLEVELAND, OHIO

"Spee-Dee" printer. Tracings, letters, invoices or any written or printed matter (unless printed on both sides) may be rapidly duplicated.

Blue Print Machine

★ Either blue prints or black-and-white prints (Directo process) may be quickly and economically obtained with the new **"Spee-Dee"** printer, a portable table model which can be plugged into any standard electric outlet. It comes in two sizes: for prints up to 12 by 18 in. and up to 18 by 24 in. The printing is done on a curved glass surface which gives perfect contact; besides tracings, any letter, invoice, or other written or printed matter except a sheet printed on both sides can be reproduced, states manufacturer. **Peck and Harvey,** 4325 Addison St., Chicago.



Women's Helmets

★ These new "protector helmets" for women war workers are moulded from vulcanized fibre into a one-piece, light-weight seamless crown. The underside of the crown is reinforced by a second piece of preformed fibre. The helmet weighs approximately 25% less than the standard safety hat for men and is provided with a hammock, which rests directly upon the wearer's hair, instead of the usual type of safety hat lining. An adjustable chin strap holds it in place on the head.

Strauss protector helmet for factory women. It weighs approximately 25% less than men's standard safety hats.

These helmets are available in black or tan and in small and medium head sizes. **The Strauss Co.,** 977 Ewart Bldg., Liberty Ave., Pittsburgh.

» «

Air Power Stacker

★ The **Air Power Stacker,** a portable elevator powered by an air motor, is now being offered by the **Lewis-Shepard Sales Corp.,** Watertown, Mass., for use in explosive atmospheres. This air-driven stacker is produced in the same speeds and capacities as the standard Lewis-Shepard line of electric powered stackers, also in standard hinged and telescopic types. Upper and lower limit stops operate automatically to prevent any possibility of an override when lifting or lowering.

» «

Absorbent Floor Compound

★ Oil soaked floors, responsible for a large proportion of the over 10,000 accidents which occur daily in industrial plants, can be rendered harmless, it is claimed, through the use of **"AleXitE Absorbit,"** a grease-and-oil-absorbent floor compound. This substance is said to be dielectric, fireproof, light, dry and odorless. When thoroughly soaked with oil, it becomes a dustless sweeping compound that can be swept up and re-used several times. **AleXitE Engineering Co.,** Alexander Bldg., Colorado Springs.

M. S. A. "Skullgard-Eyeshield." A downward flip of the head brings it into the proper protective position.

Eye Shield

★ Designed for quick attachment to "Skullgard" safety hats and caps of this manufacture, the new **M.S.A. Eyeshield** gives non-fogging eye protection against the hazard of flying particles. The transparent plastic shield is so hinged under the hat's brim that it is readily positioned before the eyes in proper facial curvature by a downward flip; when not in use, it lies flat against the brim. In either position, full vision is afforded.

Instructions for attachment to hats and caps already in service are given in Bulletin CE-18, available on request to **Mine Safety Appliances Co.**, Braddock, Thomas and Meade Streets, Pittsburgh.

Black & Decker electric drill with new plastic housing.

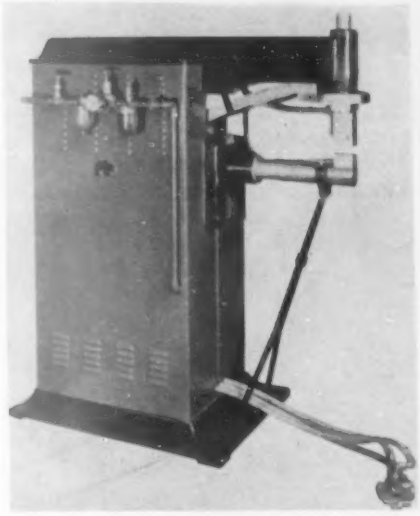
Plastic Drill Housing

★ **Black & Decker,** Towson, Md., is now equipping its ¼ and ⅜ in. standard electric drills with housings of a new plastic material called "Drillite." This material is made with a shredded cotton duck base, said to give it a high impact resistance and enable it to withstand considerable hard wear. Both sizes of drill are offered with either end handle (illustrated) or side handle control; they are equipped with pistol grip and trigger switch and with Universal motors, operating on either A-C or D-C.

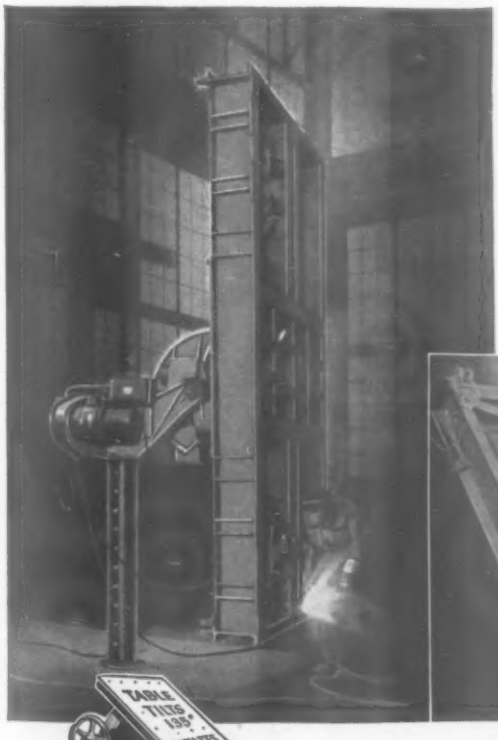
» «

Spot and Projection Welders

★ A complete line of new spot welding and projection welding machines is now being offered by **Universal Power Corp.**, 4300 Euclid Ave., Cleveland. These are of the air-operated press-type design in capacities from 10 to 150 kva. Equipment includes tube-type timers with magnetic or water-cooled-tube contactors for control of squeeze, weld, and hold times or providing for pulsation welding. Air operation controlled by a foot switch permits fast work with a minimum of operator fatigue. Transformer and electrodes (or welding dies) are water cooled.



Universal press-type projection welder. Tube-type timer provides for electronic control of squeeze, heat, cool, hold and off times.



C-F POSITIONERS

. . . Is this faster, better welding method your answer?

C-F POSITIONERS are changing fabricating methods on many products . . . have made it faster and cheaper to *weld* them by eliminating handling problems, greatly increasing output and permitting all welds to be made strong, smooth and flawless.

Once weldment is placed on a C-F POSITIONER welder himself does all further "handling" freeing cranes and crane crews for other work. With the push of a button or turn of a hand wheel C-F POSITIONERS rotate weldments or assemblies 360° and tilt them 135° beyond horizontal, so that all sides, top and bottom can be welded "down hand".

C-F POSITIONERS come in a large variety of models and types in capacities from 1200 lbs. to 30,000 lbs. All are adjustable for height and are pedestal mounted to give maximum floor and working clearance.

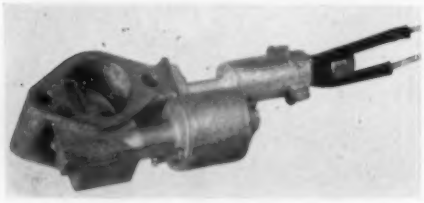
With C-F POSITIONERS it is now both practical and profitable to *weld* many products that have been produced by other means heretofore.

Write for Bulletin WP 22.

CULLEN-FRIESTEDT CO.,
1309 S. KILBOURN AVE. CHICAGO, ILLINOIS

Gas Engine Governor

★ An improved electro-vacuum gasoline engine governor is offered for insertion in the engine intake manifold. With this device, arc welders may be run at an adjustable reduced engine speed until the arc is struck, when the engine comes at once to full speed. Shortly after welding ceases, the engine will drop back to the reduced speed. **Universal Power Corp.,** 4300 Euclid Ave., Cleveland.



Universal gasoline engine governor. It permits engine to be run at reduced speed until the arc is struck.

» «

Skin Cream

★ To help fend off the misery of industrial dermatitis (skin disease), there is now offered a skin cream using as its base "AleXitE," a micaceous mineral found in the Colorado Rockies. This mineral is broken down by a grinding-flotation process into a fine powder, the microscopic particles of which are platelike and overlap each other like the scales of fish. When the cream is applied, the flaky mineral is said to form a barrier which protects the skin against the effects of fumes, scale, dust, iron oxide, ultraviolet rays, etc. **AleXitE Engineering Co.,** Alexander Bldg., Colorado Springs, Colo.

» «

Multiple Operator Welders

★ **Hanson-Van Winkle-Munning Co.,** Matawan, N. J., is now offering multiple-operator welding machines of 1,500 amp capacity at 70 volts. This equipment, designed especially for use in shipyards, will enable a large group of weldors to work from one motor-generator set. Two types are available: stationary and semi-portable.

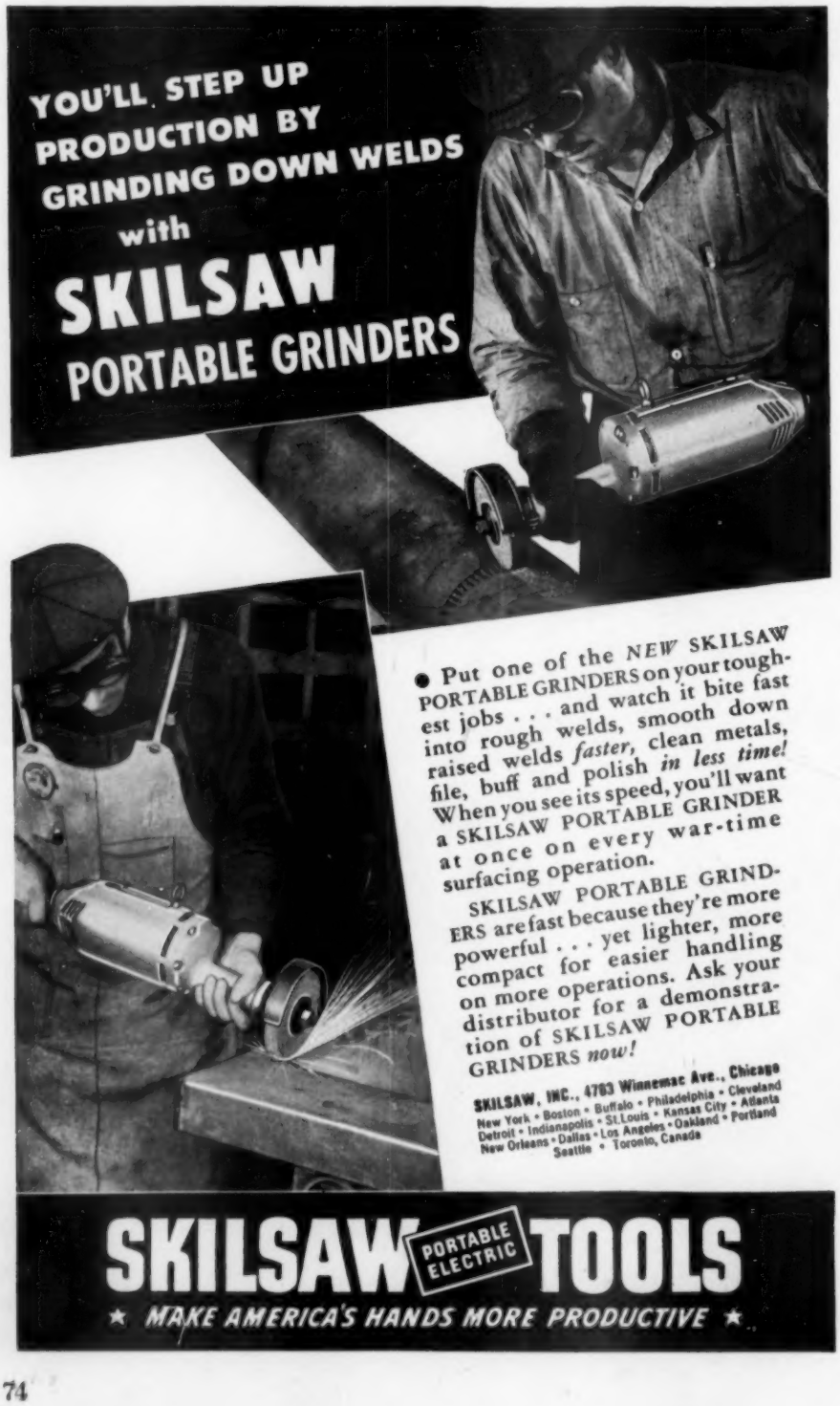
In the stationary type, the drive motor can be either A-C or D-C. If A-C, the motor can be of either the synchronous or induction type, for 60 or 25 cycle operation. Motors can be of any voltage: 220, 440 or 550 for A-C or D-C or 2,300 volts for the A-C drive. The motor-generator, motor starter panel and generator control panel must be permanently installed.

The semi-portable units are factory assembled and wired. Each unit is a complete drive and control mounted on a single bed plate, and it may be picked up and moved by a crane. The driving motor can be either A-C or D-C, of the voltages and types previously mentioned.

Heavy-duty gauntlet to protect against cutting edges. Extra leather is used on the entire palm, extending up the first joints of all fingers and well around to the back of the forefinger.

Reinforced Gauntlet

★ **Steel Grip Safeguard No. 12725** is an improved type of steel reinforced gauntlet for heavy-duty work. The steel ribbons are placed diagonally to assure protection against the cutting edges of the material handled. The entire palm is reinforced with an extra piece of leather, and the thumb is patched and strapped for extra strength and service. All closing seams are stitched with steel thread. Grain leather renders the glove flexible despite the heavy reinforcements. These gloves may be bought as pairs, all rights, all lefts or any combination of rights and lefts as required. **Industrial Gloves Co.,** Danville, Ill.


YOU'LL STEP UP PRODUCTION BY GRINDING DOWN WELDS with SKILSAW PORTABLE GRINDERS
● Put one of the NEW SKILSAW PORTABLE GRINDERS on your toughest jobs . . . and watch it bite fast into rough welds, smooth down raised welds faster, clean metals, file, buff and polish in less time! When you see its speed, you'll want a SKILSAW PORTABLE GRINDER at once on every war-time surfacing operation.
SKILSAW PORTABLE GRINDERS are fast because they're more powerful . . . yet lighter, more compact for easier handling on more operations. Ask your distributor for a demonstration of SKILSAW PORTABLE GRINDERS now!
SKILSAW, INC., 4783 Winnemac Ave., Chicago
New York • Boston • Buffalo • Philadelphia • Cleveland
Detroit • Indianapolis • St. Louis • Kansas City • Atlanta
New Orleans • Dallas • Los Angeles • Oakland • Portland
Seattle • Toronto, Canada
SKILSAW PORTABLE ELECTRIC TOOLS
★ MAKE AMERICA'S HANDS MORE PRODUCTIVE ★

Now...AN INDUSTRIAL G-R 38

300 AMPERE G-R WELDER (RANGE 70-420 AMPERES) FOR ONLY $380 *with* POWER FACTOR CORRECTION

Extensive demand for this reliable heavy-duty G-R Welder permits a substantial price reduction, creating at $380 (with power factor correction) a peak value in industrial welders. G-R 38, built for sustained welding loads, has earned an important place in shipyards and industrial plants wherever the welding of medium or heavy thickness metal is carried on.

This machine is characterized by exceptional welding characteristics throughout its range. *Stepless Control*... high efficiency ... power factor correction... and safety for the operator are other G-R advantages.

GLENN-ROBERTS COMPANY

1009 FRUITVALE AVENUE, OAKLAND, CALIFORNIA
2107 ADAMS STREET, INDIANAPOLIS, INDIANA
P. O. Box 1814, Washington, D. C.

INCREASE Your Welding Production
SAVE Valuable Cleaning Time
OBTAIN Better Welds
By Using ANTI SPATTER
For Better Welding

CHECK THESE DEFINITE ADVANTAGES

- Economically applied by brush on surface surrounding and including portion to be welded.
- Works on any metal that can be arc welded, because no fusion of spatter occurs where Anti-Spatter is applied.
- Saves time by speedier, better looking production.
- Has no injurious effect on metals.
- Allows painting over weld by wiping off with wet rag or the employment of the usual degreasing procedure. Wipe off with dry rag otherwise.
- Is non-inflammable and non-toxic.
- Has no disagreeable odors.
- Permits smoother, closer knit weld with less slag.
- Eliminates practically all weld rust.
- Reduces man-hours and tools for clean-ups to a minimum.

GET
ANTI-SPATTER
TODAY

Waste motion is our enemy. Order a supply of Anti-Spatter today to cut down on it.

STEEL SALES CORPORATION

WAREHOUSES
Chicago, Ill., 3348 S. Pulaski Rd., Phone Crawford 4400
Detroit, Mich., 5151 Wesson Ave., Phone Tyler 6-3000
St. Louis, Mo., 4565 McRee Ave., Phone Grand 5255

DISTRICT OFFICES
3348 S. Pulaski Road, Chicago, Illinois — Milwaukee — Minneapolis

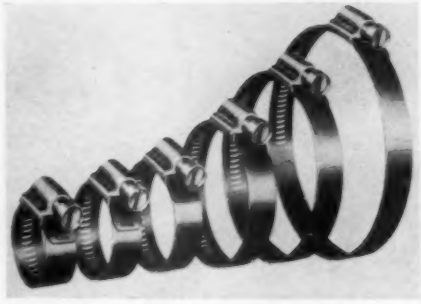
Anti-Fogging Compound

★ A new product, **"No-Fog,"** manufactured by the **Carhoff Co.**, 3050 Kensington Road, Cleveland, is said to prevent the fogging, steaming, frosting or perspiration of glass. It thus improves vision when applied to spectacles, safety goggles, windows or windshields.

» «

Hose Clamps

★ A new line of hose clamps in fourteen sizes for hose from ¾ to 4 in., ID, has been introduced by **The Aircraft Standard Parts Co.**, 1711 Nineteenth Ave., Rockford, Ill. These clamps were designed to meet the requirements set forth in Army Air Force Specification No. 25529.



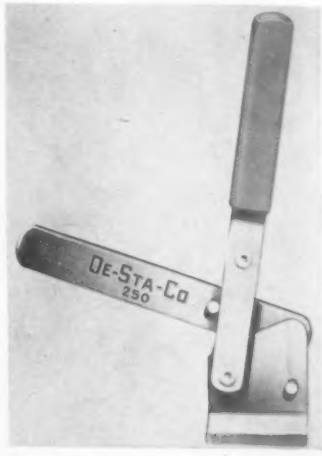
"Aero-Seal" hose clamp. A line of 14 sizes is provided for hose from ¾ in. to 4 in., ID.

The new **"Aero-Seal"** hose clamps are self-locking and are stated to be virtually impossible to loosen, even with severe vibration, as long as the band is under tension. The clamp consists of a ⅞ in. steel band punched with holes which mesh with a worm in the housing welded to the fixed end of the band. The worm is turned by a screw driver to loosen or tighten the clamp.

» «

Plastic Clamp Grip

★ A new grip made of heavy extruded plastic is now being supplied as standard equipment on most of the toggle clamps in the **De-Sta-Co** line. Extending the full length of the handle, the new grip has the appearance and physical properties of rubber. Unlike rubber, however, it is not affected by oil or grease, according to this manufacturer. **Detroit Stamping Co.**, 372 Midland Ave., Detroit.



A new plastic grip for De-Sta-Co toggle clamps is said to provide cushioned protection for the hands in both locking and releasing.

» «

Soldering Flux

★ To meet the problem of soldering with low tin content solders is **Lloyd's No. 6 Soldering Fluid**, a new flux that is said breaks down lead-rich solders into a fluid that will flow into inaccessible places. This flux may be used for soldering jobs on zinc-coated sheet metal, lead-coated sheet metal, (also lead burning jobs), tin plate, Terne plate, brass, copper, steel and all types of sweat fittings. A free sample will be mailed to any company making a direct request. **Lloyd S. Johnson Co.**, 2241 Indiana Ave., Chicago.

VULCAN

Means POSITIVE Cycling . . . and CONSISTENT Uniformity . . . for Faster War Production!

100-TON DIRECT FIRED VULCAN FURNACE, FOR STRESS RELIEF, ANNEALING, NORMALIZING

Used in the production of castings for naval construction, the large VULCAN Furnace illustrated is equipped with full program temperature control by which the rates of heating, holding and cooling can be predetermined. Automatic furnace pressure control assures consistent temperature uniformity on the work and good surface conditions. Although direct fired, a convection effect can be secured automatically, with forced cooling under program control. Car and door are motorized, with push-button control stationed at front of furnace. Oil or gas fired.

Consult VULCAN engineers regarding your heat treating or heating requirements, and get their recommendations based on many successful installations.

VULCAN CORPORATION
1785 CHERRY STREET, PHILADELPHIA, PA.

Late Copies

If this issue of THE WELDING ENGINEER did not happen to reach you as promptly as in years past, please remember that Uncle Sam's mail may have to wait occasionally for soldiers and guns to pass on the main track. Yes, many mail deliveries are now irregular, even within cities, but the mailman is actually doing a magnificent job, all things considered.

(Trade Mark Registered)

Specify Titan Welding Alloys

TO ASSURE UNIFORMLY SOUND, STRONG, DUCTILE BRONZE WELDS

Doubly-Deoxidized Welding Alloys:

PENN BRONZE

TITAN BRONZE

TITAN MANGANESE BRONZE

Doubly-Deoxidized PENN BRONZE, TITAN BRONZE and TITAN MANGANESE BRONZE Welding Rods have proved their definitely superior welding qualities over a period of many years and under the most exacting requirements.

The Double-Deoxidization process, developed by Titan engineers, definitely increases the ductility of the weld metal, reduces fuming to a minimum and assures a sound, dense, strong weld.

Descriptive literature sent upon request

TITAN METAL MANUFACTURING CO., BELLEFONTE, PA.

TITAN WELDING RODS

● Little wonder the "spotlight" of Miller AC efficiency is "shining" in **more** shops and industrial plants every day! WHY?—simply because Millers: (1) **Increase** welding speed. (2) **Improve** welding quality. (3) **Reduce** welding costs. That's the endorsement of Miller operators everywhere. To which we add, **Millers will do the same for YOU!** Write for full information. Prompt delivery **. . . Right Now!**

MILLER ELECTRIC MANUFACTURING COMPANY

Sales: Richmond, Indiana • Factory: Appleton, Wisconsin

Do You Agree?

Spence's Metal

Question: What is Spence's Metal? Can it be welded? *M. McF.*

Answer: Strictly speaking, Spence's Metal is not a metallic material. It is a hard, tenacious, metallic looking material which is widely used in the making of gas or air-tight joints when fitting up glass laboratory equipment.

Spence's Metal is a solution of certain metallic sulphites such as those of iron, lead or zinc in molten sulphur. It melts at about 320 F. Because of this low melting point, it cannot be welded. In making fittings of Spence's Metal, it is melted and molded in a manner similar to that used with sulphur.

» «

Flame-Hardening

Question: What is flame-hardening and what are the principles involved? *C. C.*

Answer: Flame-hardening is a heat-treating process that has been defined as the surface hardening of parts made of quench-hardenable material by means of the rapid heating of the region to be hardened with an oxy-acetylene flame and subsequently cooling the region by the application of a suitable quenching medium.

The principles involved are in no way different from the underlying principles of all processes of hardening by heat treating. The distinguishing feature of this process has been the inherent flexibility of the torch-quench unit, which permits the hardening of such surfaces of a part as may require high hardness without hardening adjacent sections wherein such hardness is not required or may, in fact, be undesirable.

For a complete discussion of flame-hardening and the principles involved, refer to the comprehensive three-part article, "The Hardening Flame," which appeared in the January, February and March, 1943, issues of THE WELDING ENGINEER.

» «

Welding Is Safe

Question: I understand people frequently receive electrical shock when arc welding. Is it safe to do arc welding? *S. J.*

Answer: In working with any electrical apparatus there is a likelihood of electrical shock. However, in the case of arc welding the shock, as a rule, presents no potential hazard. As for the safety of arc welding, it is so safe that the National Safety Council, Inc, has made no attempt to keep records of injuries that might be incurred by weldors. If this work rated as hazardous, surely records would be kept!

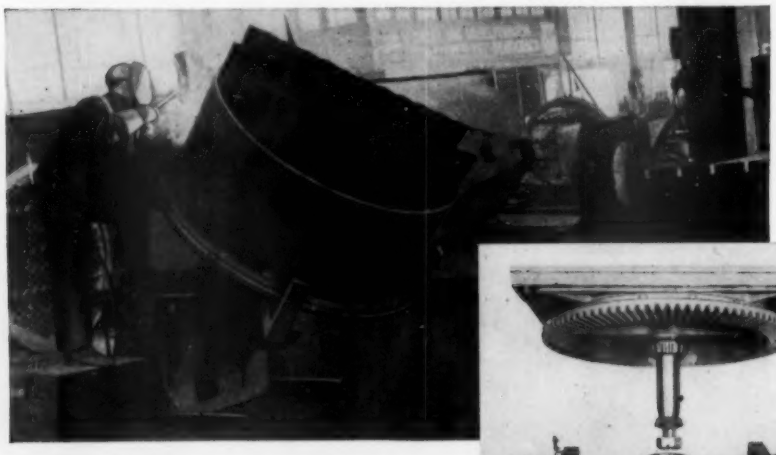
» «

Temperature Determination

Question: Can the temperature of steel be determined by its changing colors as it is being heated? *L. C. M.*

Answer: A rough approximation of the temperature of steel may be made by observing its color during heating. There are several factors, however, which determine the accuracy of the results obtained. These are: the lighting condition under which observations are made; the color of reflecting surfaces in the vicinity of the piece being heated and the experience of the observer. The tabulation below should serve as a general guide.

Temperature, F.	Color
752	Red, visible in the dark.
885	Red, visible in the twilight.
975	Red, visible in the daylight.
1,077	Red, visible in the sunlight.
1,292	Dark red.
1,472	Dull cherry-red.
1,652	Cherry-red.
1,832	Bright cherry-red.
2,012	Orange-red.
2,192	Orange-yellow.
2,372	Yellow-white.
2,552	White welding heat.
2,732	Brilliant white.
2,912	Bluish white or dazzling white.



SMOOTH ACCURATE ROTATION... *Another Ransome feature for faster and better welding*

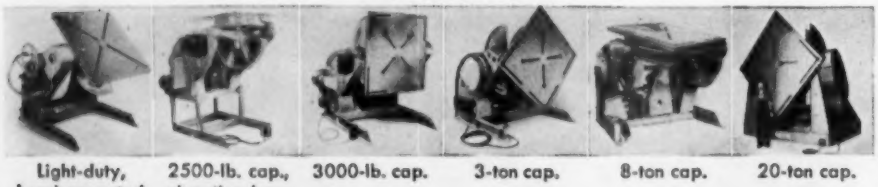
Indicative of the correct design and trouble-free construction of Ransome Welding Positioners is the use of two Timken Tapered Roller Bearings on the main spindle shaft.

With these bearings, the shaft is kept in perfect alignment . . . particularly important in maintaining a true circular path when using automatic welding heads on circular work.

Another advantage is that the grease-packed Timken Bearings require a minimum of attention.

Base frames, table tops, and table supporting yokes, on all Ransome Positioners, are of heavy welded construction. Hand-operated and motor-operated types . . . capacities up to 20 tons.

» *Write for literature*



Light-duty, hand-operated | 2500-lb. cap., elevating base | 3000-lb. cap. | 3-ton cap. | 8-ton cap. | 20-ton cap.

Ransome WELDING POSITIONERS

INDUSTRIAL DIVISION • RANSOME MACHINERY COMPANY • DUNELLEN, NEW JERSEY

Now—Get Both

VARIABLE SPEED

and a

SELECTIVE SPEED LOCK

On this revolutionary new

BENTLEY

Welding Positioner

★ Now—one of the biggest advances in welding positioner ease and speed that have been made in the last 10 years. Here's why:

★ If you're doing a single-piece job, just use the variable speed foot accelerator and rotate the table at any speed you want for the job.

★ But if it's a multiple-piece job, start with the variable speed foot accelerator until you've found the exact speed best suited to the work. Then hold that speed by locking the selective speed lever. The table will continue to rotate at the speed you've selected.

★ If the piece requires two different speeds—as for a large outer and a smaller inner circumference, that's easy. Just shift the selective speed lever to a predetermined position. No trouble at all. This and other features reduce the demand on the operator's attention—help you get more than 5 men's output for every 4 men working.

Model shown has variable and selective speed rotation, plus air-operated hydraulic tilt through 90°. Also available in following models: Model AM-5—Manual rotation with air-actuated hydraulic tilt . . . Model MM-5—Manual rotation with manual tilt . . . Model MV-5—Variable speed rotation with manual tilt.

Write for full description and prices

BENTLEY WELDERY, Inc.

SYRACUSE, N. Y.

LITTLE WAYS TO MAKE BIG SAVINGS IN CRITICAL MATERIALS AND TIME

NO. 4 OF A SERIES

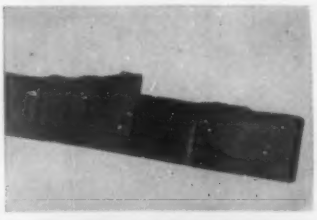
Phos-Copper Brazing

CAN "TAKE IT"

These 4 tests prove it!

1. TENSILE STRENGTH TEST. Two ⅛" x 1½" pieces of copper were brazed together (lap joint). Under a pull of 25,000 pounds per square inch the *copper itself broke*—the Phos-Copper joint *held*.

2. FATIGUE TEST. In a fatigue testing machine, the Phos-Copper joint (left) was tested against a 20% silver-solder joint (right). Note that piece brazed with Phos-Copper *broke above* the joint while silver-soldered piece *broke at* joint.



3. DUCTILITY TEST. This bronze cap was brazed to a copper tube. The assembly was then crushed in a powerful press. Pressure shattered the cap, yet notice how the Phos-Copper joint still holds cap and tube tightly together.

4. PRESSURE TEST. Using Phos-Copper, this bronze cap was brazed to a $\frac{1}{16}$" copper tube. Under a hydrostatic pressure of 2200 pounds the *tube burst* but Phos-Copper joints held tight and sound. (Excellent for marine piping.)

★ ★ ★

Write for "Brazing with Phos-Copper". It contains easy-to-understand drawings showing how to make good brazing easy; a discussion of joint design—complete with "good and bad design" drawings. And there is page after page of photographs which may suggest valuable brazing applications for you. Get your copy of B-3201 today. Of course, no obligation. Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., Dept. 7-N. J-90472

Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

News of the Industry

WPB Advises Brazing for Tool Reclamation

The cutting tool is actually the fulcrum of most war industry, Howard Coonley, director of the WPB Conservation Division, pointed out in a recent statement. He advised each war production plant to make a study of its tool handling problems and to adopt a company-wide "tool care" policy centering around a strong educational plan.

Widespread adoption of tool-tipping practices could mean a saving of 75% of the 36,000 tons of "tippable" tools estimated as being needed in 1943, according to Mr. Coonley. High speed tool steels, he said, contain approximately 20% of the following critical alloying metals: tungsten, molybdenum, vanadium, chromium and cobalt.

Broken cutting tools, suggested Mr. Coonley, should be cut up into smaller pieces to be used as cutting tips. These may then be brazed into shanks made of plain carbon steel, thus conserving the critical alloy steels that would otherwise be required for new tools.

« »

New Distributors for Resisto-Loy

Four new distributors have recently been appointed by The Resisto-Loy Co., Grand Rapids, Mich., manufacturer of hard-facing rods. These are: Brown-Wales, 493 C Street, Boston; Brown-Wales, 120 Middle Street, Lewiston, Me.; Universal Power Corp., 4300 Euclid Ave., Cleveland, and the Arcway Equipment Co., 3717 Filbert St., Philadelphia.

» «

Electric Arc Supplants Indian's Bow and Arrow

Armed with a modern electrode, T. J. Sloan, husky six foot, 265 lb Shawnee tribesman, finds welding big pipe a faster and more exciting way of making a living than the traditional buffalo hunts of his ancestors. Sloan, who has been welding for nine years, is one of six Indian weldors in the United States. He is also one of the best weldors working for Contractors H. C. Price, Inc., on the "Big Inch," world's largest oil pipe line.

The accompanying picture shows Sloan tack welding a joint of the 24 in. diam pipe. He is said to keep the line-up crew busy feeding him the big pipe sections for tacking prior to roll welding.

Courtesy, The Lincoln Electric Co.

T. J. Sloan, full-blooded Shawnee Indian of Shawnee, Okla., tack welding a joint of the world's largest (24 in. diam) oil pipe line.

TYPE CB
TRIPLE-DUTY
HAMMER

Ask for

CMD

WELDERS' CHIPPING HAMMERS

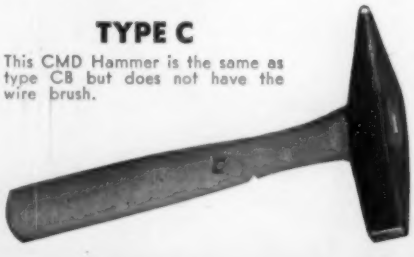
The Leader for 18 Years

Type CB has a convenient wire brush which can be easily replaced when worn. The head combines chisel and drift. Like all CMD Hammers, it is well balanced for easy use from any position—especially important for cleaning overhead welds. Weight, 16 oz.

Because they are light in weight, easy to handle and are durably made of the finest materials including carefully tempered heads that hold their cutting edges longer, CMD Chipping Hammers have been first choice of welders since 1925.

TYPE C

This CMD Hammer is the same as type CB but does not have the wire brush.



Order from your Welding Supply House!

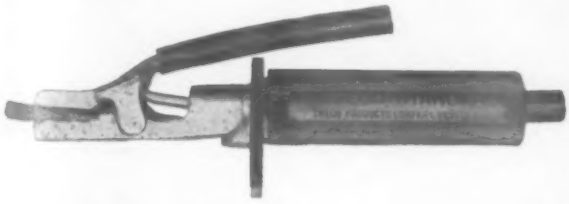
If they cannot supply you, order direct! Descriptive circular sent free upon request.

CHICAGO MANUFACTURING AND DISTRIBUTING COMPANY

Dept. W., 1928 West 46th St., Chicago, Illinois

TWECO STANDARD ELECTRODE HOLDERS

400 Amps . . . 3/32"-5/16" Rod



Standard Holder with Guard.....$3.50
Standard Holder less Guard..... 2.75
Less in dozen and larger quantity.

DELIVERY?—YES!!

Delivery is still prompt on all TWECO PRODUCTS.

Why? The answer is we manufacture *only* Cable Connections for Electric Welding and are tooled to deliver the goods.

See your local distributor or write us for more information on:

TWECO GROUND CLAMPS
ELECTRODE HOLDERS
CABLE CONNECTORS
CABLE LUGS

Request Bulletin No. 1943-G

TWECO PRODUCTS CO.

English at Ida Wichita, Kansas

TWECO PRODUCTS

For Handy, SPEEDY Welding . . .

LYON-Raymond

Hydraulic Elevating Welding Table . . .

With Convenient Foot-Pedal Control

It's easy to use this efficient Welding Table for all sorts of job-shop work. And standardized repeat operations are faster and better the LYON way, too. This unit makes experienced welders more efficient—helps newly trained operators do reliable work. Safe, sure foot-pedal *Hydraulic* elevating and lowering gives you swift, just-right positioning. Pivots on full circle with 15° indexed positions. 2000 lbs. capacity . . . no ratchets or gears. Write today for prices on this fine LYON unit! Ask for Bulletin No. 131.

Lyon Hydraulic Welding Positioner Tilts Hydraulically—as Well as Lifts and Revolves!

Step up your "production welding" with this LYON Positioner!—in many cases as much as 50%. It elevates a full 14"—revolves a full 360°—and tilts a full 90°. Get full information on this advanced-type positioner—Bulletin No. 131.

LYON-Raymond Corporation
MATERIAL HANDLING EQUIPMENT
233 Madison St. Greene, N. Y.

AMPCO-TRODE
THE Only COATED ALUMINUM BRONZE WELDING ROD
Seven Grades of Ampco-Trode - high strength aluminum bronze electrodes

Choose a grade exactly suited to your work . . .

Note the applications these grades cover:

Ampco-Trode 10—All purpose coated aluminum bronze electrode — for arc-brazing manganese bronze, brass, steel or malleable iron. Higher strength and greater hot ductility than any other bronze weldrod.

Ampco-Trode 12—A soft, tough bronze with good bearing properties—Ampco Metal Grade 12—for bronze overlays wearing against soft steel.

Ampco-Trode 16—A tough bronze of high tensile strength — Ampco Metal Grade 16 — for bronze welds and overlays with good resistance to wear and impact.

Ampco-Trode 18—A strong bronze with good ductility—Ampco Metal Grade 18—unequalled for bronze overlays requiring the maximum bearing and wearing properties.

Ampco-Trode 20—A hard bronze—Ampco Metal Grade 20 — for building up bearings working against hardened steel.

Ampco-Trode 21—A very hard bronze — Ampco Metal Grade 21—used for overlaying cast iron, steel or bronze for very hard bearings or on dies to reduce die wear and marking of the sheet metal.

Ampco-Trode 22—An extremely hard bronze — Ampco Metal Grade 22—for overlaying drawing dies to avoid draw lines on the sheet metal being formed.

This amazing series of aluminum bronze rods has proved its merits in U. S. ordnance plants, ship yards, industrial plants. Try Ampco-Trode coated bronze electrodes. Where you have difficult conditions to overcome, you will find that the result is a credit to you.

AMPCO METAL, INC.

Department WR-5 Milwaukee, Wisconsin

New 20 in. Pipe Line, Indiana to East Coast

Upon the recommendation of the Petroleum Administration for War, Defense Plant Corp. has agreed to finance the extension of a 20 in. petroleum products pipe line to the harbor area of New York City. This new section is to be constructed by War Emergency Pipelines, Inc., and is expected to be done by the end of the year. It will complete the link from Seymour, Ind., to the East Coast, providing for a capacity movement of approximately 235,000 bbl of petroleum products per day from the Beaumont-Houston area of Texas.

The first sections of the line—a 16 in. pipe from Baytown and Port Arthur to Beaumont, Tex., and a 20 in. pipe from Beaumont to Norris City, Ill., and Seymour, Ind.—were approved by Defense Plant Corp. about two months ago at a cost of $44,000,000. Completion of the Seymour-New York area section will bring the overall cost of the entire project to approximately $75,000,000.

» «

G-E Bridgeport Works Wins Army-Navy "E"

The Bridgeport Works of the General Electric Co., Bridgeport, Conn., has been given the Army-Navy Production Award for excellence in the production of war equipment. Commenting upon the bestowal of this high honor, H. L. Andrews, G-E vice-president, said: "The men and women of General Electric, Bridgeport Works, will cherish their esteemed 'E' as a symbol of their resolve to work until final victory is achieved."

« »

Weldors Wanted for Shipyards

First class weldors are now in demand and are urgently needed for shipyard and building construction in the vicinity of Virginia and Maryland. Those interested are requested to communicate with the national headquarters of the United Brotherhood of Weldors, Cutters and Helpers of America, 3605 Laclede Ave., St. Louis.

« »

American Brake Shoe To Simplify Its Name

In line with the present vogue for streamlining, American Brake Shoe and Foundry Co. has shortened its corporate name. Stockholders at their recent 42nd annual meeting voted to drop the "and Foundry," leaving the company name simply, "American Brake Shoe Co."

In explaining the change, President William B. Given, Jr., said, "For years our customers and stockholders have been calling us 'Brake Shoe,' referring to us that way as an organization and not as a manufacturer of brake shoes. We are merely legalizing a name by which we have long been known. For years we have been making thousands of parts in many kinds of metals, metal alloys, non-metallic compositions and fabrics in addition to brake shoes. But since 'Brake Shoe' seems to stick to us, we are adopting it as the tieing name of all our divisions."

» «

Use of Welded Steel Pipe Saves 20,000 Lb of Copper

A saving of 20,000 lb of copper—most critically short metal of 1943—was achieved last year by the General Electric Co. in the manufacture of power rectifiers. The saving was accomplished by substituting welded steel pipe for copper tubing and by eliminating cast fittings in favor of welding. Some 2,500 man-hours were also saved by the substitution.

« »

Photoelasticity Conference

The 17th semi-annual meeting of the Eastern Photoelasticity Conference and Symposium on Experimental Stress Analysis will be held on May 13, 14 and 15 at the Rackham Memorial Bldg., 100 Farnsworth St., Detroit, under the auspices of the Chrysler Institute of Engineering, Highland Park, Mich.

» «

Meehanite Metal Moves

The Meehanite Metal Corp. and the Meehanite Research Institute of America, Inc. announce the moving of their headquarters from Pittsburgh to the Pershing Building, New Rochelle, N. Y.

ALL ASBESTOS INSULATION
NO MAGNETIC BLOW
LOW OPERATING COST
LOW MAINTENANCE COSTS
INSTANTANEOUS HEAT SELECTION
LOW INITIAL COST
LICK WELDING PROBLEMS at COMMANDO SPEED
WITH
MARQUETTE
REGISTERED U.S. PAT. OFFICE
A.C. ARC WELDERS
Training over obstacle courses with live ammunition makes Commandos "tough and fast." Tough and fast . . . that's a good description of the way a MARQUETTE licks today's welding problems in all-out war production.
Five streamlined models, available for 10 day delivery, produce 150 to 400 amperes of perfect current for fast, flawless, low cost welding of light work or the heaviest metal structures.
Send today for free 24 page illustrated booklet on how to cut cost, save metal and boost production the MARQUETTE way.
MARQUETTE MFG. CO.
INCORPORATED
Minneapolis, Minn.
FOR PROMPT DELIVERY ORDER MARQUETTE ELECTRODES
MARQUETTE
REGISTERED U.S. PAT. OFFICE
A.C. ARC WELDERS

ABOUT PEOPLE

T. M. **Cummings** has been appointed executive vice-president and general manager of the Progressive Welder Co., Detroit. He has been vice-president of this concern since its founding in 1933. For the first year, Mr. Cummings was in charge of manufacturing and engineering, but he was later placed in charge of sales development. In his new post, he will be in complete charge of all company operations.

« »

Judson **C. Travis,** assistant to the president of Handy & Harman, New York City, has been elected a director to take the place of the late H. H. De Loss. Mr. Travis, who has headed sales and advertising activities of Handy & Harman for many years, was made assistant to President G. H. Niemeyer, five years ago.

» «

G. Donald Spackman has been promoted from general manager to vice-president in charge of operations of Lukens Steel Co. and its subsidiaries, By-Products Steel Corp. and Lukenweld, Inc., all of Coatesville, Pa. He will be responsible for the overall operations of the three companies and their coördination for maximum production for the war effort.

B. W. Hancox has resigned as vice-president of Good Health Associates, Inc., in order to join the Engineering Department of the Harris Sales Co., Lansdowne, Pa. **Harvey S. Plummer,** formerly sales manager for Carlile & Doughty, has also joined the Harris Sales Co. and will handle its newly organized customer service department.

» «

Dr. Charles M. Slack, well known in the field of electronics research and for his contributions to the development of an ultra high speed X-ray machine that is making possible the wartime study of bullets as they crash through armor plate, has been appointed assistant director of research at the Westinghouse Lamp Div., Bloomfield, N. J. In his new position, he will direct experimental work on various lamp and electronic problems. **Dr. John W. Marden,** who has been assistant director of research for the past 15 years, will also continue in this position but will be given complete charge of metals research.

» «

Frederick Salditt, vice-president in charge of sales of the Harnischfeger Corp., Milwaukee, has been elected a member of the board to fill the vacancy of the late Joseph H. Harnischfeger. **H. H. Erkelenz,** executive engineer, has been elected vice-president in charge of engineering. **Herman Menck,** works manager, has been made vice-president in charge of manufacturing; **W. F. Heilman,** secretary, and **F. J. Hartmann,** assistant secretary and assistant treasurer.

Edward Beard White has been appointed sales manager for the western territory for Eutectic Welding Alloys Co., New York City. Mr. White, who has had eighteen years in technical and industrial fields, has recently been engaged in welding engineering and in sales promotion in connection with the Castolin Eutectic low temperature welding process.

» «

Edgar N. Yost, formerly chief inspector of the Carnegie-Illinois Steel Corp., has been appointed division superintendent of the new Armor Plate Plant, which is operated as part of the company's Gary Works. The Armor Plate Plant is the property of the United States Army, being built at the Army's request with Army funds. It converts slabs into finished armor plate, ready for welding into tanks.

» «

Dr. Ancel St. John has been granted leave from the St. John X-Ray Service, Inc., Long Island City, N. Y., to join the Ordnance Dept., Washington, D. C., as a senior metallurgist.

» «

A. D. Lewis, west coast general manager for Knu-Vise, Inc., will add to these duties those of west coast service and sales representative for Progressive Welder Co. He will make his headquarters at 4328 San Fernando Road, Glendale, and will cover the state of California for Progressive Welder and Knu-Vise.

HERCO VARIABLE CORE ARC WELDERS *for:*

MODELS FROM 150 TO 1500 AMPERES WITH OR WITHOUT POWER FACTOR CORRECTION

24 hour per day operation.
Exact heat control.
Increased production.
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Ease of operation.

Inquire about MAGNETIC CLAMPS for quick positioning and alignment.

HERCULES ELECTRIC & MFG. CO. INC.

MANUFACTURERS OF THE PRECISION WELDER WITH THE STREAMLINED ARC

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William J. Norman has been appointed assistant district manager of the Waverly plant, Newark, N. J., of the United States Steel Supply Co., United States Steel Corp. Subsidiary. **Walter P. McGuire** has been made manager of the company's Philadelphia sales office.

» «

Eighteen General Electric industrial electronic specialists have been appointed to help industry with various problems of electronic applications. These men and the local G-E offices at which they will make their headquarters are: **I. C. Diefenderfer** and **D. C. Hierath**, New York City; **J. F. Getz**, Philadelphia; **A. J. Moore**, Boston; **W. B. Frackelton**, Chicago; **L. E. Donahue**, Los Angeles; **J. A. Setter**, Denver; **I. F. Conrad**, St. Louis; **A. D. Boardman**, San Francisco; **L. B. Parsell**, Detroit; **L. R. Elder**, Portland, Ore.; **Frank C. Neal, Jr.**, Dallas; **R. H. Jackson**, Atlanta; **K. H. Keller**, Cleveland; **R. C. Norris**, Cincinnati; **A. M. Dawson**, Pittsburgh; **B. Cogswell**, Buffalo; **L. F. Stone**, Newark.

» «

Several changes are announced in the personnel of the application engineering organization of The Lincoln Electric Co. **H. H. Stahl** of the Philadelphia office has been transferred to Boston as district manager; **R. J. Shepherd**, formerly of the Toledo office has gone to the Philadelphiha office; **C. M. Richardson**, formerly of the Moline office, goes to the Toledo office as application engineer and district manager, and **W. J. Barrett** has been transferred from the Moline office to the Detroit office. **C. B. Herrick** of the Philadelphia office has been given leave of absence to assist the Jefferson Boat Works, Jeffersonville, Ind., with its welding problems.

» «

Sidney R. Snow has been appointed assistant to vice-president (operations) of American Steel & Wire Co., Cleveland, subsidiary of the U. S. Steel Corp. In this new position, he will handle operating costs. **John R. Gaut**, formerly assistant general superintendent of the company's Waukegan Works, Waukegan, Ill., has been named general superintendent at Waukegan, succeeding Mr. Snow.

» «

W. H. Dodge, former supervisor of the rate bureau, has been made general supervisor of the traffic department, western district, United States Steel Corp. Subsidiaries. He is succeeded as assistant supervisor of the rate bureau by **H. W. Huebner.**

» «

Perry J. Rieppel, welding engineer, has been named to the research staff of Battelle Memorial Institute, Columbus, O., where he will assist in welding research on industrial and governmental projects. He was formerly associated with the Buffalo plant of the Curtiss-Wright Corp.

» «

F. O. Cooper has been appointed manager of the sheet and strip bureau, metallurgical div., Chicago district, of the Carnegie-Illinois Steel Corp. He has been connected with this company and other United States Steel Corporation subsidiaries since 1905.

» «

Leland M. Hogan, F. L. Schneider, Carl I. Laraway, and **Frank J. Shanaberg** have been appointed to new positions with the American Welding and Mfg. Co., Warren, O. Mr. Hogan will be eastern district manager with headquarters in New York City; Mr. Schneider will be Chicago district manager; Mr. Laraway will act as comptroller of operations, and Mr. Shanaberg will be manager of the company's product development department.

Died . . .

Harry Herbert De Loss, a director of Handy & Harman, New York City, died March 28 at Clearwater, Fla. He had served as vice-president in charge of manufacturing for many years, during which Handy & Harman established its position in the refining of precious metals. He was treasurer of the company from 1905 to 1915, vice-president from 1915 to 1923 and a director from 1905 until his death.

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6 Models—Ranging from 100 to 500 Amps.
Priced from $69.00 to $395.00
Immediate Deliveries
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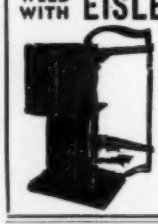

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Popular models and sizes. Gas and electric welding supplies; TIPS for various makes of torches. Safety Equipment and Clothing.
Large stocks—prompt deliveries.
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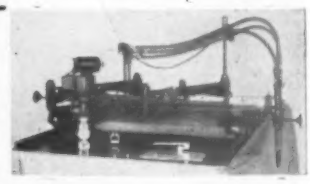

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Send for descriptive circular.
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TYPE E-1, for arc welding
Assure dense, ductile and strong welds.
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Ready fluxed, with the correct proportions of flux on each rod, assuring: Ease of Control; Free-Flowing Characteristics; Increased Welding Speeds.

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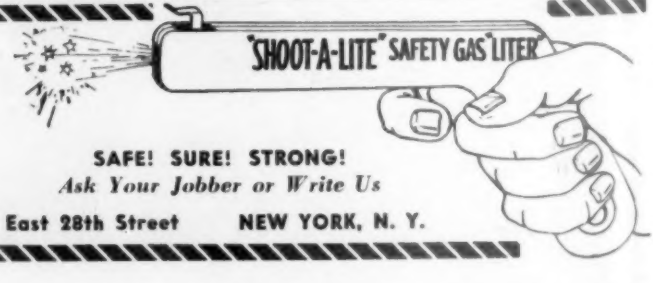
For Welding and Cutting Torches
SHOOTS STRAIGHT TO THE SPOT!



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The First Complete Welding Rod Processing Plant Ever Assembled Under One Roof For Demonstration Will Be Shown At Cleveland, Ohio Early in June.

★ This plant, complete from wire cutting and feeding machine to final inspection, weighing and packing, will be completely assembled in production line and will be in operation, actually processing welding rods. It is one of a number we have sold to a foreign power. More are under construction, and we should like all foreign purchasing commission officials, welding engineers and manufacturers interested in an operation of this scope to see this plant while it is in operation.

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Its Questions and Answers

- Cutting
- Flame-Treating
- Materials
- Inspection
- Many Other Subjects

How much do you know about welding? This book answers the 500 questions which T. B. Jefferson, editor of THE WELDING ENGINEER, has most frequently been asked and heard asked of others about welding, cutting, materials, flame-treating, inspection, etc. Get your copy of this highly informative, illustrated book TODAY.

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THE ECONOMICAL HARD FACING METAL

- A non-ferrous alloy of chromium molybdenum, copper, manganese and carbon
- Deposits show extreme resistance to abrasion; withstand severe impact without shattering
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- For A.C. or D.C. Arc and Oxy-Acetylene application
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- Ideal for setting carbide inserts due to high tensile strength of the deposits, which approach 90,000 psi. Wherever severe impact and abrasion are encountered, use RESISTO-LOY.

ISOROD . . . Self-hardening alloy that is truly foregable and highly abrasion-resistant. Easily applied. Deposits of Isorod can first be controlled for a hard facing metal deposit and then by a slight change in technique, provide a deposit with extremely high tensile strengths for joining parts subject to heavy service.

Write for Application Details and Specifications

THE RESISTO-LOY CO.
GRAND RAPIDS, MICH.

Helpful Literature Just Published

The following reviews are of recent publication of interest to those in the welding industry. Unless otherwise stated, they may be obtained without cost by writing to the manufacturers listed.

Welding Fittings Case Study

As No. 1 in a series of case studies for the marine industry, **Tube Turns, Inc.**, Louisville, Ky., has just prepared a four-page, letterhead-size bulletin on the use of welding fittings in ship piping. This gives comparative data and drawings on a typical auxiliary exhaust section designed with welding fittings versus cast fittings and flanged construction. Use of welding fittings, it is pointed out, resulted in savings of 11¾ in. in overall space, of about 40% in weight, and of 28 flanges and 112 bolts and nuts that were required in the flanged construction.

» «

Weld Cleaning Folder

Available on request to jobbers and weldors interested in weld cleaning is a new circular from the **Atlas Welding Accessories Co.**, 307 Boulevard Bld., Detroit. This folder describes the present Atlas line of 14 tools, including chipping tomahawks, symbol hammers and brushes.

» «

Farm Maintenance Bulletin

Bulletin 433, "Maintenance of Farm Implements by Arc Welding," presents a digest of efficient and economical arc welding techniques and procedures to be followed in keeping farm equipment in good repair. A total of 47 photographs are reproduced to support the text, which covers such topics as "arc weld surfacing," "hard-facing worn parts," "building up worn parts," "repair of broken machinery," and "building and altering equipment." A copy of this 12-page, letterhead size booklet will be sent on request to **The Lincoln Electric Co.**, Cleveland.

» «

"New Parts from Old"

The above is the title of an eight-page, letterhead-size booklet just published by **The International Nickel Co., Inc.**, 67 Wall St., New York City. Using a worn pump shaft as a practical example, this booklet explains and illustrates the step-by-step procedures for reconditioning the shaft by: (1) machining the worn section and refinishing, (2) building up by welding, (3) metal spraying and (4) electroplating.

» «

Salvaging Defective Castings

Suggestions for salvaging already machined castings and parts that have small foundry defects or which show machining errors are given in a new 4-page folder from **Eutectic Welding Alloys Co.**, 40 Worth St., New York City. This bulletin, **"Improved Method for Welding Cast Iron,"** discusses principles of a low temperature welding process by which readily machineable welds free from heat stresses and distortion may be obtained. The "Castolin Eutectic" alloys suitable for salvaging defective castings are listed and classified under the four headings of: (1) cast iron, (2) alloy steel, semi-steel and malleable iron castings, (3) aluminum, magnesium, die castings, and (4) brass, bronze, nickel and alloys.

» «

Hair Guard Bulletin

A four-page, 7½ by 11 in. bulletin describes the line of "StaSafe Hairgards" available for the head protection of women workers. **Standard Safety Equipment Co.**, 232 West Ontario St., Chicago.

MANGANAL

(Reg. U. S. Pat. Office. U. S. Patents 1,876,738—1,947,167—2,021,945)

11 to 13½% Manganese Nickel Steel

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What more can you do to win the war?

Yes, you invested 10% or more for War Bonds, turned in your aluminum pots and pans for airplane parts, collected scrap metal to be used for guns and ammunition. BUT—

Are you overlooking the fact that you can save a great deal more steel by rebuilding by welding your worn and broken equipment than by throwing it on the scrap pile?

Take a look around your yard or plant. Do you see parts that are not in use that you think might be repaired by welding the Manganal Welding Process way, such as shovel and dipper teeth, tractor tread grousers, gears and rollers, gyratory, roll, jaw crushers, dredge pump shells, impellors and side plates, dipper, buckets, lips and cutters, cement and other crusher hammers, sprockets, liners, etc.?

These and many other parts are daily being repaired by the use of Manganal Welding Products, which are especially designed for the purpose of building up parts that are worn or broken due to severe impact and abrasion. If you have any parts that are subjected to these same wear conditions but are not sure whether Manganal could be of any use, drop us a line. We will be glad to tell you whether or not Manganal can be used on your particular application and at the same time we will advise you the name of our nearest distributor, most of whom employ welding engineers, who are able to advise and assist the user in the best method of using our products.

Perhaps you have an application that unknown to ourselves would save others a great deal of time, money and steel. Let us know and we will be glad to pass along the information to others who might be interested.

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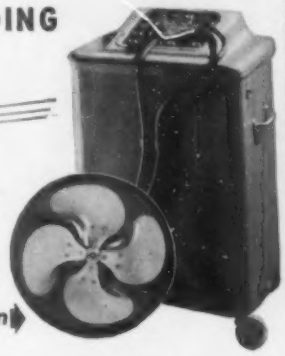
CONTINUOUS WELDING
NOW JUST A
BREEZE



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Continuous War Time Duty
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Our fighting men need the stuff. They can't wait while naturally cooled machines "cool down". That's why we built into the new Ergolyte 250F a powerful cooling fan, added extra-heavy insulation. Avoid time delays, danger from burning out due to heat stress. Speed up war work. Make your next welding machine an Ergolyte 250F. Write for information today.

SPECIFICATIONS
Current Range: 15-250 Amp. Input Voltage: 230-460 Volts. Frequency: 60 cycles or to order. Phase: Single or operates on one phase of 2 or 3 phase current. Electrode size Range: 1/16"—3/16". Heat Steps: 24. Size: 18" x 12¾", height 31½". Weight: 215 lbs.

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Save time. Save labor. Save moving heavy assemblies. Take your hand grinders, sanders, wirebrushers, drills, buffers, polishers and power files direct to the job with handy Stow Flexible Shaft Mobile Power Units. These versatile machines clean up in a hurry the hard-to-get-at jobs that so often form bottlenecks—especially the irregular shaped or heavy pieces that can't be done on ordinary machine set-ups.

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Hard-Facing Booklet

The many advantages of hard-facing (of particular significance in wartime) are outlined in a new 12-page, 6 by 9 in. booklet entitled **"Hard-Facing with Coast Metals."** A tabulation of the rods most generally used for both oxy-acetylene and arc hard-facing processes gives properties of the deposits, Rockwell hardnesses and applications to specific products. Another tabulation lists the various specific applications under such headings as "Agriculture," "Brick and Clay," "Excavating," "Foundries," etc. and gives the identifying numbers of hard-facing rods which are suitable for each application. **Coast Metals, Inc.**, 1232 Camden Ave., S. W., Canton, O.

« »

Safety Equipment Handbook

A comprehensive 32-page, 6 by 8¾ in. handbook, **"How To Make Your Safety Equipment Last Longer,"** is now ready for free distribution to industry. This well-illustrated publication covers every type of personal protective equipment such as protective hats, gas masks, respirators, safety clothing, etc. and details the "do's and don'ts" of safety equipment care in a form readily adaptable for the instruction of equipment users. The M.S.A. handbook is available without cost to any responsible official upon request to the **Mine Safety Appliances Co.**, Braddock, Thomas and Meade Streets, Pittsburgh.

» «

Refrigerated Welding Bulletin

Technical and descriptive **Bulletin No. F-43** covering the "Frostrode" process of refrigerated welding has just been issued by **Frostrode Products,** 19003 John R. St., Detroit. The four-page, letterhead-size folder gives the design and operating features of the "Frostrode" system, which includes refrigerator units, refrigerated welding electrodes, replaceable electrode tips and adapters enabling the conversion of any standard resistance welder to refrigerated welding. A composite chart of production runs by users of the process is reproduced as evidence of the increased production being obtained in the welding of 0.064, 0.040 and 0.020 gauges of aluminum alloys by the new system.

« »

Tool Salvage Booklet

Details of a method for repairing and salvaging damaged cutting tools and dies are given in an eight-page, letterhead-size booklet published by the **Gorham Tool Co.**, 14400 Woodrow Wilson Ave., Detroit. The method (see page 35) makes use of a new high speed steel welding metal recently developed by this company.

» «

Safety Catalog

A wide range of industrial safety equipment providing protection for the head, eyes, nose, throat, lungs and other parts of the body is illustrated and described in the new 25th edition of the **Cesco Catalog.** The 52-page, letterhead-size book covers various types of protective lenses, goggles, welding helmets and shields, respirators, masks, guards for grinders, toe guards, etc. **Chicago Eye Shield Co.**, 2300-C Warren Blvd., Chicago.

FROM THE PATENT OFFICE

Heat-Retarding Lens

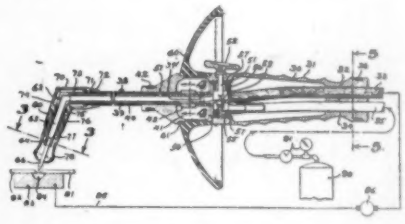
2,314,363. **Harold R. Moulton,** Southbridge, Mass., assigned to **American Optical Co.,** Southbridge. Filed Oct. 6, 1939. Issued March 23, 1943.

A heat-retarding material comprising a number of substantially flat and colorless pieces transparent to visible light but having a relatively high absorption of infrared rays. These pieces are joined in contiguous edge to edge relation by a transparent plastic bonding to produce a sheet-like, optically homogeneous structure. Since the index of the refraction of the separate pieces is substantially the same as the index of refraction of the bonding material, the resultant unit will have a minimum light diffusing effect.

» «

Heliarc Welding Torch

2,314,628. **Vladimir H. Pavlecka,** Pacific Palisades, Calif., assigned to **Northrop Aircraft, Inc.,** Hawthorne, Calif.



An electric arc welding torch for welding in a shield of inert gas. Elements are a refractory electrode, a tube concentrically positioned around the electrode and flared to form an expansion chamber toward the end of the electrode, and means for supplying gas through the tube to the expansion chamber in order to blanket the arc during welding.

» «

Spot Welding Circuit

2,314,691. **John W. Dawson,** Auburndale, Mass., and **Ralph N. Stoddard,** East Orange, N. J., assigned to **Westinghouse Electric & Mfg. Co.,** East Pittsburgh, Pa. Filed June 13, 1939. Issued March 23, 1943.

Pertaining to a spot welding circuit, this patent covers means for controlling the supply of current to the spot, including an electronic tube to be rendered conductive by the application of a potential greater than a predetermined critical value, and means for applying a periodic potential having a substantially sloping wave front superimposed on a potential which gradually increases in magnitude. During the earlier pulsations the current conducted is insufficient for welding, but as the net potential applied rises above the critical value the current becomes sufficient for welding.

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trains quickly, thoroughly

Classes for MEN and WOMEN

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- Standard units can be combined for sequencing and cycling, to control "weld" as well as "squeeze," "hold," and "off" in continuous operation.

Prices from $32 up

Inquiries regarding special timing problems invited.

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No. 1 Cast Iron Welding Flux.
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No. 4 "Brax-Cast" Flux for Bronze Welding Cast Iron.
No. 5 Aluminum Flux for Cast Aluminum.
No. 8 Aluminum Flux for Sheet Aluminum.
No. 9 Stainless Steel Welding Flux.
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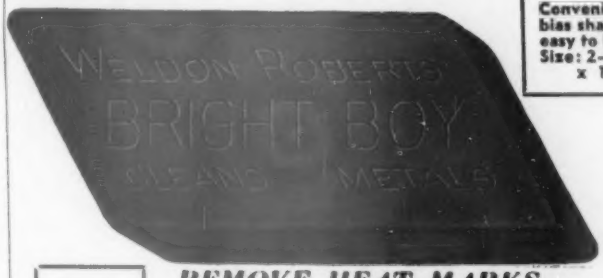

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Safeguard your sight. Good sight is a precious possession; take the best possible care of your eyes. Ever-Klear Cover Lens will aid you in doing this. They will not pit or allow molten sparks to fuse on the surface, insuring clear vision at all times.

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"Hevikoat"—SP2 (AWS E6012) straight polarity D-C for poor fit up. RP (AWS E6010) reverse polarity high tensile, high ductility. Approved by American Bureau of Shipping.

"Stainarc"—stainless and corrosion resistant steel electrodes—all analyses.

"Luminarc"—high quality, all purpose coated aluminum.

"Brazarc P"—Phosphor Bronze *"Brazarc S"* Silicon Bronze.

"Cast Iron-Arc R"—all purpose. *"Cast Iron-Arc B"* for machinable welds.

FOR GAS WELDING
A complete line of "Universal" bare welding rods are available for all types of gas welding.

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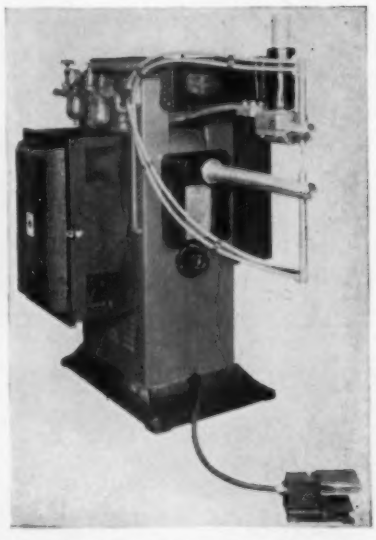

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Write for Spot Welder Bulletin

UNIVERSAL POWER CORP.
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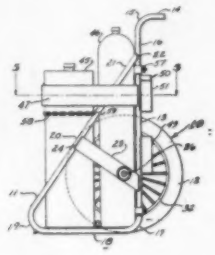
Cylinder Truck

2,313,868. **Leslie H. Garlinghouse,** Los Angeles. Filed Feb. 16, 1942. Issued March 16, 1943.



This patent pertains to a tandem tank cart for oxygen and acetylene cylinders. The chassis has spaced side members, each including a vertical portion, a foot portion and brace portion. An axle-supporting member is secured to the brace portion and the vertical portion on each side of the chassis. A platform is supported by the foot portion, and a transverse member extending across the cart above the platform divides it into front and rear portions to hold the cylinders. A stub axle is mounted on each axle-supporting member, these stub axles being arranged intermediate the length of the rear portion of the platform and above it. There is a wheel on each axle.

» «

Press Welder

2,313,941. **Stanley M. Humphrey** and **Melvin Max Albert Seeloff,** Warren, O., assigned to **The Taylor-Winfield Corp.,** Warren, O. Filed April 10, 1941. Issued March 16, 1943.

Resistance welding apparatus comprising in combination a fixed electrode and a movable electrode supported by a slide having rearwardly inclined bearing surfaces. A means is included to oppose the lateral movement of the slide in one direction, while anti-frictionally mounted rolls engage the slide bearing surfaces to oppose lateral movement of the slide in the other directions. A collapsible bellows is interposed between the slide-moving means and the slide; pressure exerted on the movable electrode passes through the bellows, in which a predetermined fluid pressure is maintained.

» «

Cylinder Rack

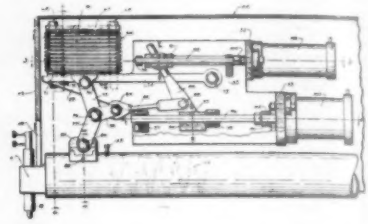
2,313,944. **Barnett A. Keener,** New Lebanon, and **Curtis G. Comer,** Dayton, O. Filed Dec. 16, 1940. Issued March 16, 1943.

A device for holding a pair of cylindrical tanks of unequal weights. The tanks are arranged side by side and held in position by elongated flexible split hoops with flattened sides. The hoops encircle the cylinders and are attached to an inverted U-shaped member so that one portion of each hoop is attached to one of the legs and the opposite portion of each hoop is attached to the other leg, the U-shaped member being eccentrically attached to the hoops in order to balance the weight of the cylinders. The hoops may be tightened for encircling the tanks, while inverted J-shaped hooks coöperate with the U-shaped member to hold the hoops in fixed spaced relation with each other. The hooks are adapted to be supported upon the shoulders of a person for carrying the device on his back.

» «

Spot Welder

2,314,099. **George S. Mikhalapov,** Hunting Valley, O., assigned to **The Baldwin Locomotive Works.** Filed May 1, 1941. Issued March 16, 1943.



This patent describes a spot welding machine having a pair of opposed electrodes, one of which is movably supported by one end of an elongated member pivotally supported at its other end. A power-operated toggle mechanism moves the elongated member into and out of welding position. The mechanism reacts against a yieldable constant pressure means when the movable electrode is in its operative position.

» «

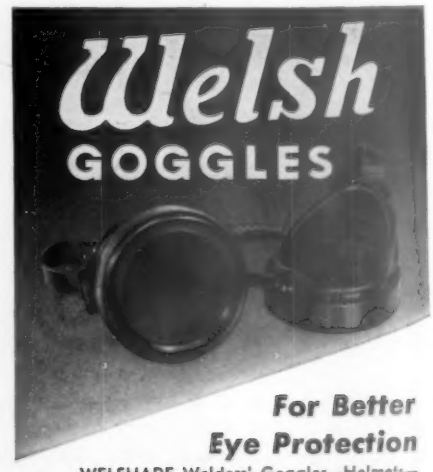
Spot Welding Electrode

2,311,750. **Franz R. Hensel** and Earl I. **Larsen,** Indianapolis, assigned to P. R. **Mallory & Co., Inc.,** Indianapolis. Filed Oct. 17, 1941. Issued Feb. 23, 1943.

A spot welding electrode composed of a copper base alloy containing 0.05% to 3% columbium and at least 90% copper. This electrode is characterized by higher hardness than cold rolled copper and by a softening temperature above 400 C.

» «

Welsh GOGGLES



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Brazing Process

2,311,878. **Robert W. Schlumpf,** Houston, Tex., assigned to **Hughes Tool Co.,** Houston. Filed April 28, 1941. Issued Feb. 23, 1943.

A process of securing in position a casting of ferrous alloy having approximately 20% chromium and 1% boron. The ferrochrome alloy is fused with the boron and cast into the desired shape; then the casting is secured to another metal object by brazing.

» «

Coated Bronze Electrode

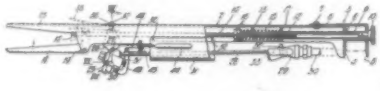
2,312,109. **John R. McDonald,** Weymouth Heights, and **Hubert N. Ruel,** South Weymouth, Mass., assigned to **Bethlehem Steel Co.** Filed April 6, 1942. Issued Feb. 23, 1943.

A welding electrode composed predominantly of copper and zinc with a coating predominantly of carbon.

» «

Flame-Cutting Apparatus

2,312,120. **Frederick H. Paddon.** Youngstown, O. Filed Sept. 20, 1941. Issued Feb. 23, 1943.

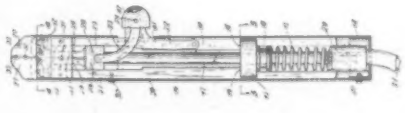


This apparatus for flame-cutting includes a longitudinally extending body member, at one end of which is a means for clamping the material to be cut. A cutting torch, movably mounted on the body member, is adapted to be moved relative to the clamping means and work held thereby.

» «

Electrode Holder

2,312,763. **William Linquist,** Cleveland, assigned to **A. L. Austin,** Cleveland, as trustee. Filed July 17, 1941. Issued March 2, 1943.



This holder has an elongated body member surrounded by a casing of insulation material. A plunger, longitudinally movable within the body member, carries a pair of clamping jaws which project from one end of the body member. An electric conductor, projecting through the opposite end, is connected with the plunger. A means is included to open the jaws when they are moved in one direction longitudinally of the body member and to close them when moved in the opposite direction. A spring moves the plunger in one direction, and a toggle moves it in the opposite direction. The middle joint of the toggle projects outwardly through the body member and casing.

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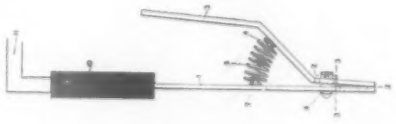
Electrode Holder

2,313,327. **Aaron Henry Erickson,** West Lancaster, Pa., assigned to **Lancaster Iron Works, Inc.,** Lancaster. Filed Jan. 18, 1941. Issued March 9, 1943.



This holder comprises a stationary lower jaw and a movable upper jaw supported by a pivot strap secured to the lower jaw. A spring tends to keep the forward ends of the jaws together, and a rounded projection on the upper jaw contacts the pivot strap so that the upper jaw may move in all directions and thereby exert a large clamping area.

» «

Carbon Electrode Improvement

2,315,346. **Joseph Arthur Musgrave Woodcock Mitchell,** Runcorn, England, assigned to **Imperial Chemical Industries, Ltd.,** a British corporation. Filed May 10, 1941. Issued March 30, 1943.

This patent pertains to the process of making shaped carbon electrodes in which the electrodes are heated to a degree sufficient to effect graphitization in the presence of catalytic amounts of non-volatile metal oxides such as the oxides of aluminum, iron, magnesium, titanium and vanadium. The improvement comprises the subjection of the electrodes to a chlorine-containing atmosphere during the cooling stage (but while the electrodes are still at relatively high temperature) in order to convert the metallic oxides into chlorides which may be volatilized.

» «

Energy Storage Welder

2,315,093. **Jacques Emile Jules Languepin,** Paris, France, vested in the **Alien Property Custodian.** Filed Aug. 9, 1939. Issued March 30, 1943.

A resistance welding apparatus comprising an iron core transformer, a condenser, means for supplying current to charge the condenser, means to discharge the condenser into the transformer, a D-C supply means and several contact devices whereby the flow of direct current is cut out in the transformer primary winding and the condenser is caused to discharge.

» «

Welding Apparatus

2,313,393. **Harry W. Mitchell,** Shaker Heights, O., assigned to **Mitchhell Metal Products, Inc.,** Cleveland. Filed August 3, 1940. Issued March 9, 1943.

A device for welding an irregularly shaped container and cover together. Welding material is deposited between the container and cover, which are held in a frame and rotated during the operation of welding.

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Resistance Welding Circuit

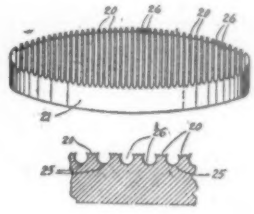
2,315,916. **Austyn L. Whiteley** and **Bertram G. Higgins,** Rugby, England, assigned to **General Electric Co.,** Schenectady, N. Y. Original application filed Jan. 5, 1940. Issued April 6, 1943.

This patent pertains to an A-C supply circuit and a welding circuit, in combination, including welding electrodes and means for controlling the pressure they exert upon the work. An electric translating apparatus is connected between the two circuits; this is controlled by excitation means and permits the transmission to the welding circuit of a predetermined value of current during a predetermined number of cycles and the later transmission of a smaller value of current during a second predetermined time interval. A timer, energized from the supply circuit, controls the excitation means in order to establish the current-time relationship previously described and also controls the pressure exerted by the electrodes, which pressure is increased during the second time interval.

» «

Metallizing Tool

2,314,902. **Arthur P. Shepard,** New York City, assigned to **Metallizing Engineering Co., Inc.,** Long Island City, N. Y. Filed April 16 and Nov. 25, 1940. Issued March 30, 1943.



This patent pertains to a rolling tool for preparing a surface for metal spraying. The tool has a plurality of circular rows of splaying and peening teeth, at least some of which rows are out of line with respect to the teeth of other rows. When the tool is rolled over previously threaded grooves of a metal surface, irregularly spaced teeth marks are cut, simulating grit-blasted marks. Continued rolling of the tool causes some of the teeth to mesh with the first-made marks and other teeth to splay and peen out of mesh, thereby giving, intermediate the grooves, a surface simulating a grit-blasted surface.

» «

Heat-Resisting Rod

2,315,466. **Joseph J. Vetter,** Hackensack, N. J., assigned to **Natural Products Refining Co.,** Jersey City, N. J. Filed March 5, 1942. Issued March 30, 1943.

A welding rod for heat-resistant applications. This rod is composed of 15% to 25% chromium, 1% to 3% silicon and 1% to 6% carbon, the balance being substantially iron. Any constituent other than those mentioned is not more than ½% of the whole by weight.

» «

Flame-Hardening Method

2,312,839. **Alfred Kullman** and **Thomas A. Waltz,** Cincinnati, assigned to **The American Tool Works Co.,** Cincinnati. Filed May 15, 1941. Issued March 2, 1943.

A method for flame-hardening the teeth of a rack without burning the edges and corners. The rack is first bounded at each side with metal buffer members, which are in metal-to-metal contact with the rack itself, and the flame is then passed across the rack teeth. Quenching follows the flame after the metal of a tooth has been heated to hardening temperature.

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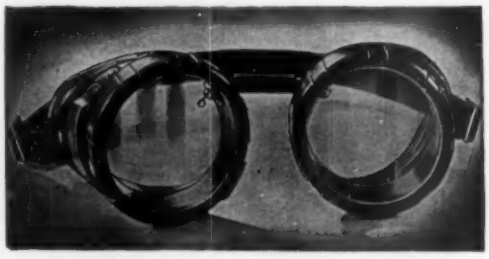

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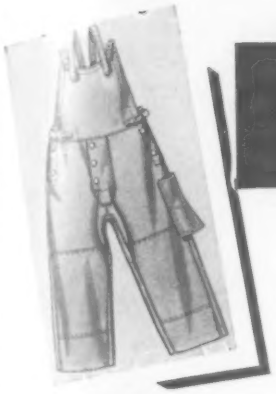

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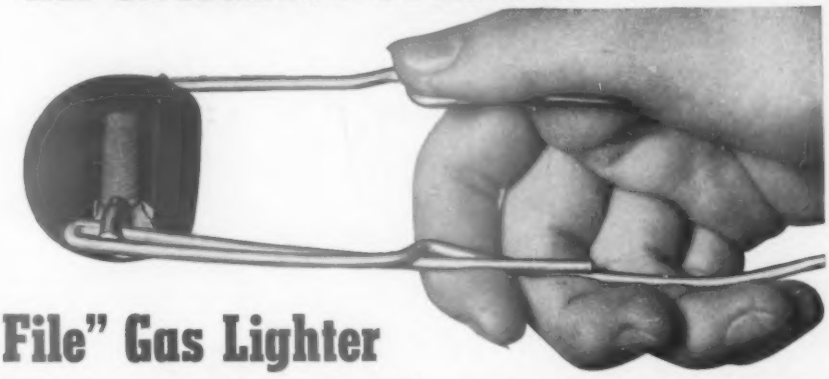

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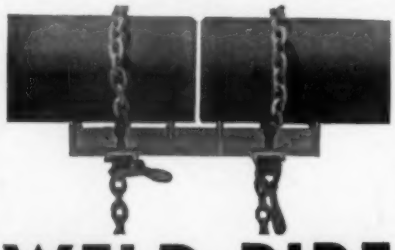

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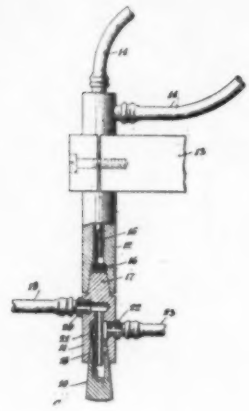
Spot Welding Electrode Holder

2,315,854. **Edman Francis Holt**, Indianapolis, assigned to **P. R. Mallory & Co., Inc.**, Indianapolis. Filed March 28, 1942. Issued April 6, 1943.



A welding electrode support comprising, in combination, a hollow tubular holder adapted to be clamped to the arm of a spot welding machine and a hollow adapter supported on the end of the holder. The adapter is formed to receive a welding electrode. Conduits for circulating cooling fluid lead to and from the holder, and independent, separate conduits for circulating cooling fluid lead to and from the adapter. Thermal insulating material retards the heat flow between the hollow portion of the holder and the adapter.

The electrode adapter is a hollow tubular body having a closed and an open end. The closed end is tapered to fit a tapered socket in the holder, while the open end has a shoulder and a stop mounted in opposed relation to the shoulder. A sleeve is rotatably and slidably mounted on this open end between the shoulder and stop.

» «

Spot Welder

2,312,938. **Hermann W. Stieglitz**, Marblehead, Mass., assigned to **Thomson-Gibb Electric Welding Co.**, Lynn, Mass. Filed Jan. 30, 1941. Issued March 2, 1943.

This spot welding machine has two cylinder members: an outside one and an inside one that is movable in the outside cylinder. By moving the inside cylinder a piston is advanced, causing a work-engaging part to move to work-engaging position. An elastic fluid at controllable pressure is introduced into the space between the head of the inside cylinder and the piston in order to urge the piston to move the work-engaging part as the inside cylinder member is moved. The elastic fluid enables the inside cylinder to continue to advance after the part has reached work-engaging position.

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